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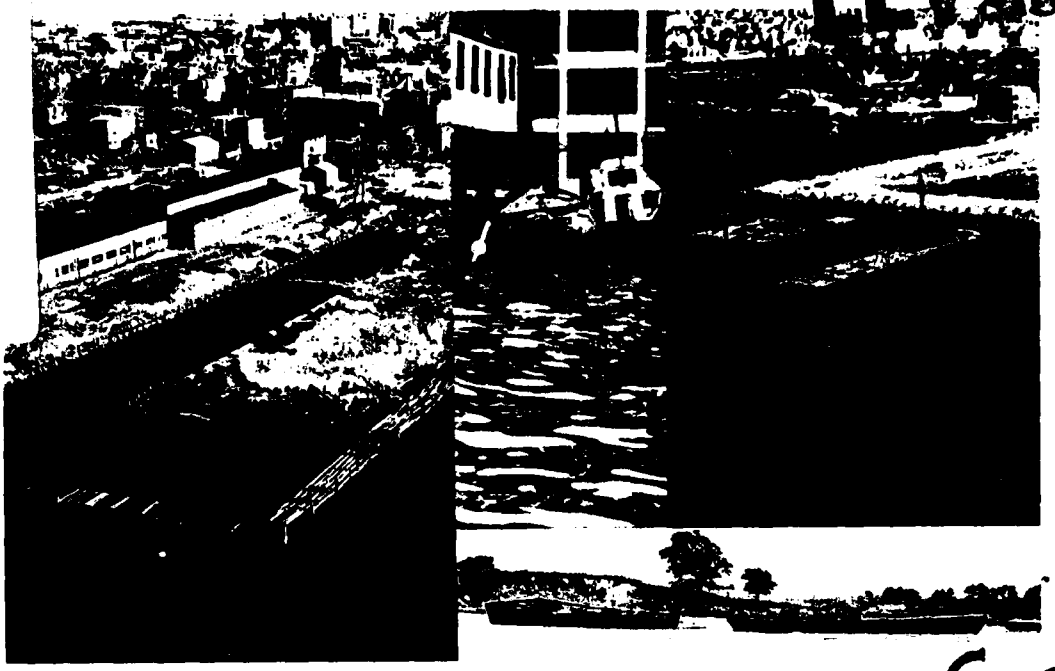

FEASIBILITY REPORT ON DEBRIS REMOVAL VOLUME 1 OF 2

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS

DECEMBER 1979
(REVISED MAY 1980)

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This study determined the engineering feasibility and environmental acceptability in removal and disposal of floatable debris from Boston Harbor. A t
A total of 533 waterfront structures were found to be sources of debris
The total volume of floatable debris and non-floatable material from these sources is estimated to be about 3.2 million cubic feet and 4,500 tons, respectively.

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BOSTON HARBOR, MASSACHUSETTS

MAIN REPORT

FOR DEBRIS REMOVAL

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

DECEMBER 1979
(REVISED MAY 1980)

SYLLABUS

The purpose of this report is to determine the engineering feasibility and environmental acceptability for Federal participation in removal and disposal of floatable debris sources that are potentially hazardous to navigation, are a suppressant of land values, and are aesthetically unpleasant. A contingent purpose is to determine the adequacy or inadequacy or existing governmental laws to maintain the harbor in a cleaned up condition.

The debris sources under investigation are dilapidated waterfront structures including those with portions dilapidated (primarily timber pile supported wharves and bulkheads), derelict (wrecked) vessels, shorefront dumps, and loose floatable debris lying on dilapidated structures and on shore. A debris inventory was prepared. The inventory has been limited to debris that is or could become floatable with the exception of certain dilapidated structures and a few wrecked timber vessels that contain some non-floatable materials. A total of 533 waterfront structures were found to be potential sources of debris. Each was examined. Of the total, 271 are considered, at the very least, in fair condition; 225 structures were identified as being so dilapidated, in part or whole, as to be uneconomical to repair. Another 37 however, were found to warrant repair. 55 sunken wooden vessels and 168 concentrations of loose offshore debris have been located around the harbor. The total volume of floatable debris and non-floatable materials from these sources is estimated to be about 3.2 million cubic feet and 4,500 tons, respectively. About seventy percent of these sources are in the inner harbor.

Plans have been formulated. They involve the determination of possible alternative strategies for ridding Boston Harbor of its debris sources, their evaluation and the selection of a plan which best meets the criteria set by the four accounts of principles and standards: National Economic Development (NED). Environmental Quality (EQ), Regional Development (RD) and Social Well-Being (SWB).

The selected plan, considered best at this time, consists of removing drift, hazardous to navigation; removing dilapidated structures; removing those portions of structures found dilapidated and partial reconstruction when the conditions and use of the partly dilapidated structure warrant repair, removing sunken (wrecked) vessels, and

loose on shore floatable debris and burying all debris sources at an existing sanitary landfill. Debris from the inner harbor would be brought via water to a site in the South Boston Navy Yard. Debris from the outer harbor would be brought via water to a site in the Hingham Industrial Center. Debris would then be transferred, reduced in size, trucked to, dumped and buried at a private sanitary landfill in Marshfield. The cost of such a plan, based on December 1979 price levels, has been estimated at $19,464,000.

Prospective tangible monetary benefits to navigation through the reduction in boat-drift collision incidents and to shorefront property through the reduction in cost in future development and the increase in residential property values are expected to total annually $1,548,400. These benefits compared with the estimated annual charges of $1,447,700 on the $19,464,000 proposed investment would result in a Benefit-Cost Ratio of 1.07, sufficient to justify Federal participation in a one-time cleanup program.

The President, in his June 1978 water policy message and more recently (May 1979) legislation proposal to Congress, proposed several changes in cost sharing for water resources projects to allow states to participate more actively in project implementation decisions. These changes include a cash contribution from benefitting states of 5 percent of first costs of construction assigned to nonvendible project purposes and 10 percent of costs assigned to vendible project purposes. Application of this policy to the Boston Harbor Debris project requires a contribution from the Commonwealth of Massachusetts of an estimated $973,000 in cash (5 percent of the $19,464,000 total estimated project first costs assigned to nonvendible project purposes, based on December 1979 price levels). This cash contribution would not be required until immediately before construction of the project and would be in addition to any other non-Federal costs required by current legislation and regulations for project implementation.

In accordance with Section 202, Public Law 94-587 (the Water Resource Development Act of 1976), the cost sharing is two-thirds Federal and one-third non-Federal for debris removal and disposal where there is no identified owner of the source of the drift or debris. As a result, wrecked timber vessels including non-floatable materials confined within the hulls of some of these vessels and loose onshore floatable debris are the only debris sources eligible for Federal cost sharing. The estimated cost of the work eligible for Federal cost sharing is $3,922,000. The local share is $1,307,000. The total Federal estimated share of the cost for the recommended plan of improvement accounting for the President's proposed cost-sharing policy would be $1,642,000, representing about 8 percent of the total project costs. (In absence of that policy, Federal share would be $2,615,000.)

The remaining project cost $15,542,000 ($19,464,000 - $3,922,000) are for the removal and disposal of sources of debris when an owner of the source of debris can be identified; $12,605,000 for removal and disposal of dilapidated waterfront structures; and $2,887,000 for the repair of partly dilapidated structures. The Federal and non-Federal total financial responsibilities are:

Item	Federal	Non-Federal
Two-third cost of work eligible for Federal cost sharing less 5%.	$1,642,000	
5% first cost of construction for nonvendible project.		$973,000
One-third cost of work eligible for Federal cost sharing.		$1,307,000
Removal and disposal of debris sources for which owners can be identified.		$12,665,000
Repair of partially dilapidated structures.		$2,887,000
Total	$1,642,000	$17,822,000
Percent share of total project costs	8	92
Total Project Cost		$19,464,000

The Division Engineer recommends that the selected cleanup plan for Boston Harbor be implemented in accordance with the President's cost sharing policy. Recommendation is subject to approval by higher Federal authority and to the conditions that local interests will provide without cost to the United States all lands, easements, and rights-of-way; hold and save the United States from damage; and enact local legislation prior to completion of the work to prevent creation of sources of drift and debris; and provide the transfer and disposal sites as necessary.

Revised May 1980

Table of Contents

List of Tables

List of Figures

LIST OF APPENDICES

THE STUDY AND REPORT

Boston Harbor's protected waters furnished a refuge for the first explorers of New England's coastline. Its hills and islands provided defensible positions on which the early settlers could establish villages. In 1625, the first settlement in Boston was established by the Reverend William Blanton. By 1660, Boston had become the main port of New England and handled nearly all the commerce with England. Its prosperity continued to increase until the 1850's, by which time Boston was a leader among American cities with worldwide trade interests. It was Boston's shipyards which built the clipper ships, the world's fastest merchant fleet at that time.

The Twentieth Century has seen a decline in the intense activity of the Port of Boston as other east coast ports with better inland connections, particularly the Port of New York, have surpassed it in importance. It has, however, remained a major contributor to the regional economic well-being. Today, Boston Harbor is not only one of the major commercial seaports on the Eastern Seaboard, but it is also the center of many recreational activities including boating, fishing and swimming.

The original development of port facilities spurred the construction of wooden shorefront structures such as wharves, bulkheads and slips. As shipbuilding technology evolved from sail to steam and from wooden to steel hulls, shorefront needs changed and structures became obsolete and were abandoned. The decline of the relative importance of the port in the regional economy and the replacement of general cargo ships by container ships and bulk carriers has led to the more intense use of berths and a decrease in the demands for shorefront land for port activities.

This, combined with the decline of city centers, has led to the abandonment of many structures without hope of replacement. They have been allowed to rot and disintegrate over the years, thus contributing large quantities of floatable debris to Harbor waters. In addition, piles of debris have been formed on the shoreline from drift and the illegal dumping of refuse. The overall result has been to produce a hazard to navigation and a visual blight.

The project described in this report involves the collection of floating debris, and the removal and disposal of its sources, derelict structures, vessels, and shoreline piles of loose debris. This will not

Revised May 1980

only remove a hazard to shipping and boating, but it will also stimulate added interest towards the development of the harbor's shorefront to its full potential for recreation.

The city of Boston has undertaken a major program of urban renewal which has resulted in a major revitalization of the city center. The revitalized zone includes the original port, now transformed into an attractive and thriving commercial and residential area. The city plans to extend this renewal activity to waterfront areas presently dominated by derelict structures whose removal will be of major benefit.

Purpose and Authority

The purpose of this report is to determine the technical, econonic and environmental feasibility of a one-time clean-up program to rid the Boston Harbor area of floating debris and its sources. A secondary purpose is to determine the adequacy of existing governmental laws to cope with the debris removal program.

This report is submitted in response to a resolution adopted on 18 March 1966 by the Committee on Public Works of the United States Senate, which reads as follows:

> "RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, that the Board of Engineers for Rivers and Harbors is hereby requested to review the reports of the Chief of Engineers on Boston Harbor, Massachusetts, published as House Document 225, Seventy-sixth Congress, 1st Session, and other reports, with a view to determining the advisability of eliminating the sources of drift and debris and other obstructions and injurious deposits that pollute the water of Boston Harbor, by removal and disposal of dilapidated structures and derelicts, and by other appropriate measures, along the shores of the harbor, and its tributary waters, that constitute possible obstacles or hazards, or produce damages to existing navigation."

Scope of the Study

This study covers the area of Boston Harbor and its waters shown on Figure 1. The following twelve communities abut the harbor (from South to North): Hull, Hingham, Weymouth, Braintree, Quincy, Boston[1/]

1/ Boston includes South Boston on the southwest side of the Inner Harbor and East Boston on the northeast side.

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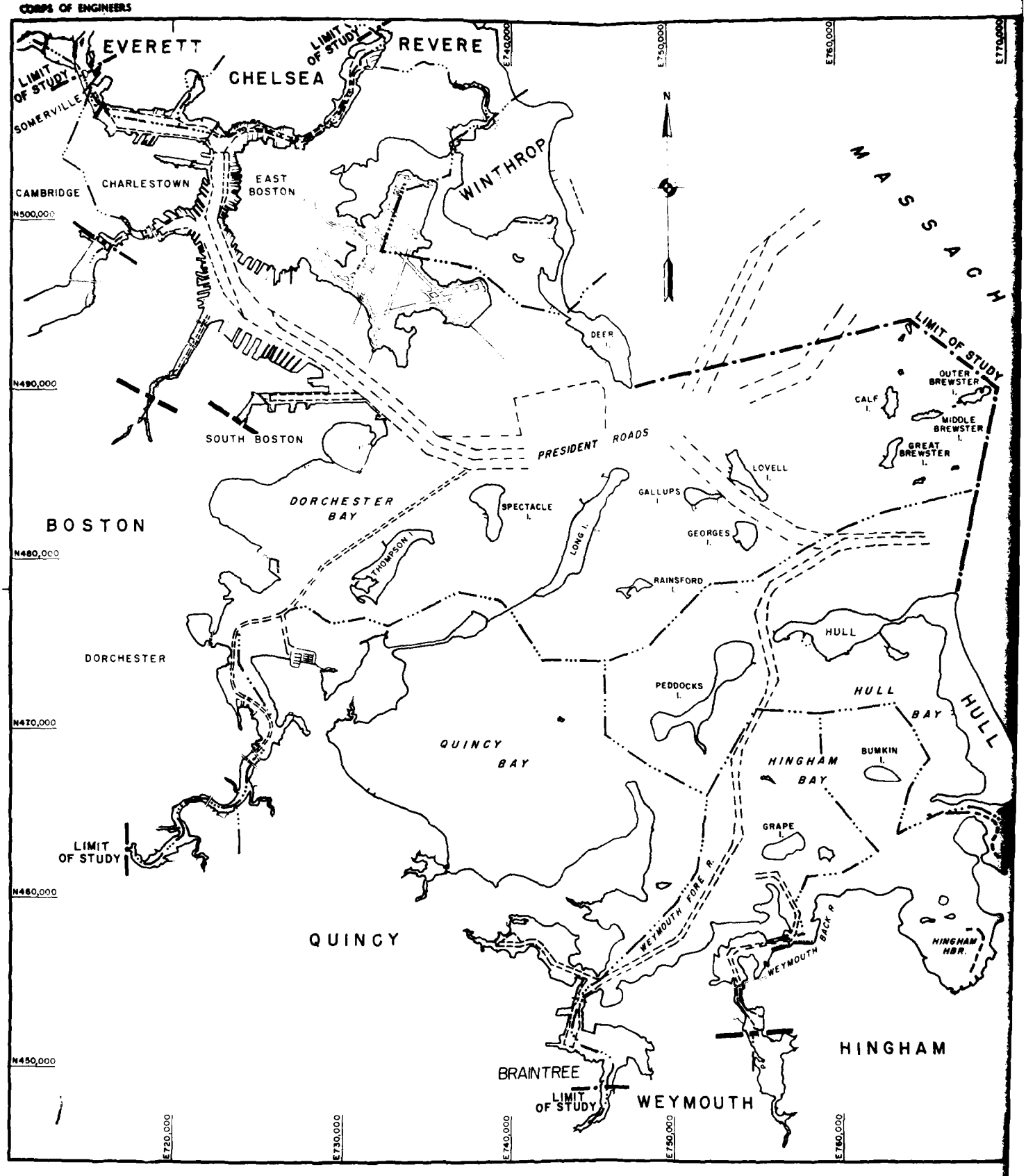

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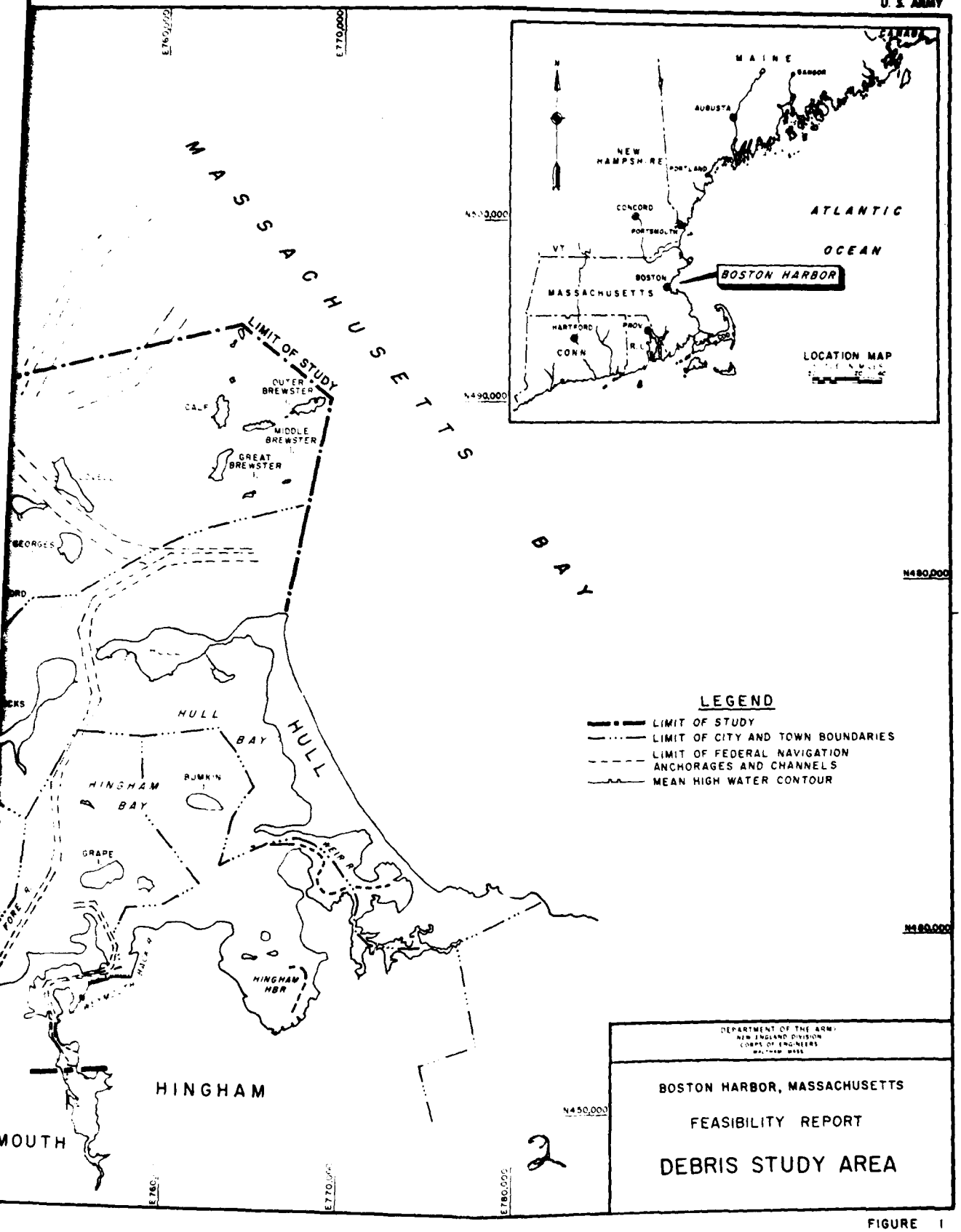


DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

BOSTON HARBOR, MASSACHUSETTS

FEASIBILITY REPORT

DEBRIS STUDY AREA

2

FIGURE 1

Cambridge, Somerville, Everett, Chelsea, Revere, and Winthrop. The depth and detail of the study are commensurate with the objective of selecting the most suitable clean-up plan of development and determining its feasibility. The division of responsibilities between federal and non-federal interests also has been determined.

Study Participants and Coordination

During the course of this study, which began in the late 1960's and early 1970's, was suspended in 1973 and resumed in 1975, coordination and liaison of varying degrees of intensity and complexity was maintained with numerous federal, state and local agencies and interests. These have included the U.S. Coast Guard, U.S. Fish and Wildlife Service, Department of Housing and Urban Development, Massachusetts Executive Office of Environmental Affairs, Massachusetts Division of Marine Fisheries, Massachusetts Port Authority, Massachusetts Department of Public Works, Boston Redevelopment Authority, Boston Building Department, officials of the cities and towns within the study area, the Office of the Governor of the Commonwealth of Massachusetts, State and United States Senators and Representatives, and such organizations as the Massachusetts Bay Yacht Club Association.

On 11 July 1967, the initial (stage 1) Public Hearing for this project was held in Boston. Attended by about 60 persons, the intention of this meeting was to provide all interests the opportunity to express their views and desires, prior to the actual start of the Corps investigation. Comments indicated that a waterfront cleanup program aimed at the elimination of all sources of floatable debris was desired. On 30 March 1971, the Corps presented a statement of status of the Boston Debris Study to city of Boston officials, as well as state and other interests. Following resumption of the study in 1975, a number of meetings were held with various local, state and federal representatives culminating in the Formulation Stage Public Meeting in Boston on 29 September 1977. This forum featured the detailed presentation of the Division Engineer's findings concerning the tentatively selected plan, including advantages and disadvantages of the various alternatives, and solicited and obtained the views and desires of the public concerning the proposed alternatives as well.

This most recent meeting aided the Division Engineer in the collection of the information necessary to formulate a final plan which will best meet the local interests' desires and needswithout exceeding the scope of the study authorization. As a result, by letter dated 15 December 1977, then Massachusetts Governor Michael S. Dukakis reported the state's endorsement of the Corps cleanup proposal and willingness to cooperate as required. By letter of 1 November 1979, Governor Edward J. King reaffirmed the Commonwealth's support of the proposal but expressed serious reservation concerning project cost sharing.

The Report

This report has been arranged into a main report and seven appendices.

The main report is a non-technical presentation of regional and local problems, needs,and effects associated with removing and disposing of debris sources from Boston Harbor. It presents a broad view of the overall study for the benefit of both general and technical readers. Included are the following: a description of the study area and the present status of debris removal and disposal in Boston Harbor; the needs for removing and disposing of debris from the Harbor and methods involved in formulating and selecting a plan for meeting the needs; a comprehensive description of the selected plan and its effects; a summary of the project economics indicating the benefits, costs, and justification; the division of project responsibility between federal and non-federal interests; coordination information; summary and statement of findings.

The feasibility report incorporates the following Appendices.

- Appendix 1 is a technical report following the same general outline as the main report, but in greater detail for the technical reviewer. It examines the problems and possible solutions in the same order as the main report.

- Appendix 2 is a part of the technical report. It details the analysis underlying the benefit and cost estimates.

- Appendix 3 contains a display of alternative plan effects, as prescribed in the Water Resource Council's Principles and Standards for Planning Water and Related Land Resources.

- Appendix 4 contains the debris inventory by community, including summary sheets and the land enhancement summary sheets.

- Appendix 5 contains the Cultural Resource Reconnaissance prepared in compliance with the Corps' responsibilities under the National Historic Preservation Act of 1966 (PL-89-665) and related legislation.

- Appendix 6, a Legal Section, contains a compilation and review of existing federal, state and local governmental laws and studies to determine their adequacy or inadequacy to correct the debris problem with recommendations.

- Appendix 7, pertinent correspondence, includes the comments and views of federal, state and local agencies which have expressed an interest in the study.

In addition, the Final Environmental Impact Statement is included under separate cover.

Prior Studies and Reports

A Congressionally authorized report had been prepared by the Corps of Engineers concerning the need for debris removal in Boston Harbor. This report was written prior to 1973 when the Office of Management and Budget reviewed a similar study report for the New York Harbor, and decided that removal and disposal of sources of floatable debris were solely the responsibility of non-federal interests. Consequently, a brief negative report on the Boston Harbor debris study was submitted.

Because of renewed interest by Congress in this problem, as evidenced by the 1974 Water Resources Development Act which authorized a debris removal project in New York Harbor, the Boston Harbor study was resumed.

RESOURCES AND ECONOMY OF STUDY AREA

Environmental Setting and Natural Resources

Boston Harbor is one of the best natural harbors on the Eastern Seaboard, and the location of the largest city and seaport in New England. Covering a tidewater area of approximately 47 square miles, the study area comprises the Harbor, the Brewster Islands at the harbormouth, estuarine portions of rivers and other waters connected to the harbor as shown on Figure 1. The harbor is part of the Boston Basin, a lowland area surrounded by a ridge of bedrock.

The shoreline of the harbor is very irregular and reflects a variety of geological forces as well as man-made alterations. A major portion of the harbor, particularly areas surrounding the city of Boston, has been filled. Continuous erosion by the sea and wind has resulted in a considerable size reduction in several of the islands, culminating in the complete disappearance of some.

The harbor is divided into the Inner Harbor, which lies north and west of a line drawn between Logan Airport and Castle Island, and the Outer Harbor. The main commercial port lies in the Inner Harbor which is surrounded by the hub of the Greater Boston metropolitan area. The Inner Harbor's shoreline is dominated by port and industrial facilities, many of which are derelict and abandoned while some have been redeveloped or converted to residential uses. The Outer Harbor is far less developed, with the developed shoreline areas being used largely for residential and recreational purposes.

Boston Harbor enjoys a temperate climate typical of its location on the easterly side of a large continent. Humidity and precipitation levels remain generally constant throughout the year. The average monthly rainfall is between three and four inches. There are 100 clear days, 106 days of partly cloudy weather and 159 days of cloudy weather with no distinct seasonal patterns. Fog occurs on an average of two days per month. Average temperatures vary from about 25°F in January to 78°F in July.

Prevailing winds in the harbor are generally from the northwest in the winter and southwest in the summer. Mean wind speeds vary from about 11.2 m.p.h. in mid-summer to 14.5 m.p.h. in mid-winter. Boston Harbor lies within the Metropolitan Boston Air Pollution Control District and is subject to the Commonwealth of Massachusetts' regulations for the control of air pollution. The air pollutant of greatest concern in the Boston area is total suspended particulates.[2/] Existing levels of particulates approach or exceed air quality standards quite frequently and limitations to control particulates may restrict industrial expansion.

Boston Harbor is an urban estuarine environment extensively utilized for fishing, recreation, shipping, and commercial and industrial activities. A uniformly high level of water pollution exists in the Inner Harbor which restricts the area's use to recreational boating, fishing and industrial activities. The Outer Harbor is suitable for swimming, fishing, boating and shellfishing with purification. The major sources of water pollution in the Harbor include combined sewer overflows, debris and refuse, wastewater treatment effluents, tributary streams, ships' and pleasure boats' discharges, and stormwater runoff.

The water, marshes, and terrestrial areas within the harbor provide habitats for a wide variety of birds, mammals, finfish, shellfish and other animals. Birds are the most abundant form of wildlife, especially on the islands. Existing types include common songbirds, migratory waterfowl and some uncommon species. Significant populations of small mammals, such as rabbits, squirrels, raccoons and skunks are associated

2/ Minute particles of solid matter (dust).

with the mainland while rats predominate on the islands. The islands also support a great abundance of different types of insects because of the abundant food and cover supply.

Marine life within the harbor is an important recreational and commercial resource. Many of the finfish species existing in Boston Harbor are actively fished and in fact some, notably flounder and cod, support a valuable commercial industry. The harbor is one of the few areas along the Massachusetts coastline which furnishes good sport fishing year round. The species fished include winter flounder, Atlantic mackerel, striped bass, rainbow smelt, Atlantic cod, pollock, Atlantic tomcod and red hake. Sport fishermen can board party and charter boats and usually catch haddock, cod, flounder, mackerel, pollock, cusk and eel. Soft-shell clams, blue mussels, crabs and lobsters are also found in the harbor, but most soft-shell clam sites are closed because of pollution and digging at the others is restricted.

A cultural resource reconnaissance of the study area located 122 structures of potential significance due to their historical association and/or potential archaeological value. Ten of these structures are located within, or directly adjacent to, properties on the National Register of Historic places. These structures have been designated to be further studied to determine their actual significance should project planning continue. A more complete description of these resources may be found in Appendix 5 of the Feasibility Report.

Derelict vessels were not examined in the reconnaissance, but will be considered in a separate study if the project proceeds to the design stage.

Human Resources

The Inner Harbor is surrounded by the metropolitan hub with its dense urban populations. As may be expected, this density drops with increasing distance from the hub. Winthrop and Hull on the peninsulas at either side of the Outer Harbor entrance are exceptions, having higher densities than nearer communities due to their restricted land areas. Boston has been subjected to a typical migration of population from the urban center to outlying suburbs; for example, the population of industrial Chelsea is now lower than it was in 1900. Typically, the more affluent people have moved out, leaving the inner cities with major fiscal problems. This pattern can be seen in Table 1. A major effort is now being made by the city of Boston to arrest and reverse this trend through a program of urban renewal. Despite considerable decline, however, residential areas adjoining the waterfront have maintained considerable cohesion through the continuing presence of strong ethnic communities.

Table 1

POPULATION CHARACTERISTICS OF BOSTON HARBOR COMMUNITIES

Community	Population			Population Density 1975 Persons/ sq. mi.	Mean Income 1969 $
	1900	1940	1975		
Hull	1,703	2,167	10,572	4,179	10,669
Hingham	5,059	8,003	19,544	865	14,807
Weymouth	11,324	23,868	56,854	3,208	12,712
Braintree	5,981	16,378	36,822	2,555	12,758
Quincy	23,899	75,810	91,487	5,498	10,097
Boston	574,136	770,816	637,986	14,052	7,330
Cambridge	91,886	110,879	102,095	14,299	7,292
Somerville	61,643	102,177	80,596	19,562	8,315
Everett	24,336	46,784	39,713	10,590	9,366
Chelsea	34,072	41,259	25,066	11,551	7,923
Revere	10,395	34,405	41,292	6,534	9,621
Winthrop	6,058	16,768	20,359	10,950	12,496

When the city of Boston was founded, the waterfront was the focus of all commercial and industrial activity. As the city grew, waterfront land was in great demand for wharves, warehouses, industrial plants, and ship building and repair facilities. As a result, residential and recreational development was almost entirely excluded and adjoining residential areas cut off from access to the Harbor. The period since World War II has seen a revolution in sea transport. General cargo ships have been replaced by container, lash barges and roll-on/roll-off ships. This has led to the development of a high level of mechanization of port facilities, fast turn around times, and rapid transport of goods to and from processing and distribution points. In recent years, shipbuilding has

Revised May 1980

been concentrated in a few highly mechanized shipyards including one which is located in Quincy. The three major military installations in the harbor area have been closed.

These changes have resulted in decreased waterfront land use and employment, and have led to many waterfront structures being abandoned and allowed to disintegrate. Others are used for marginal economic purposes often unrelated to the water, such as scrap yards, and are not adequately maintained. Nevertheless, the changes have presented Boston with a challenge and an opportunity which it has not been slow to meet. The harbor, set in one of the oldest cultural and historic centers in the United States, is now undoubtedly a major attraction for residential and recreational purposes. As may be seen in Figure 2, many old warehouses can be converted into valuable residential and commercial units and old wharves can become modern marinas, thus not only providing the City with valuable rateable properties, but also considerably enhancing its image as a place to live. As a result, there are plans for the redevelopment of many sites around the harbor including Charlestown Navy Yard, Chelsea Navy Hospital, and sections of East Boston. The removal of derelict structures is a necessary step in this redevelopment.

Boston Harbor is surrounded by the Boston Metropolitan Area, the largest in New England, with a population approaching four million. While not one of the most rapidly expanding areas in the United States, the Boston area is nevertheless maintaining a dynamic and expanding economy. Metropolitan Boston is the location of a number of internationally renowned institutions of higher learning and is the center of one of the largest concentrations of universities and colleges in the world. Many high technology firms and consulting organizations have been set up around them. On the other hand, Boston is not, and is unlikely to become, a center for heavy industry. Traditional New England labor intensive industries such as textiles have declined. Boston's continued prosperity, therefore, depends to a large extent on attracting highly skilled professional people who prefer to locate in an area where they can find social, cultural and recreational opportunities to suit their taste. Boston, with its many local cultural and historical associations, has major potential as a tourist center.

In addition to plans for residential redevelopment, there are plans for industrial and commercial redevelopment in the harbor area. The most important of these is for the redevelopment of the South Boston Navy Yard site as a ship repair yard and container terminal.

The Metropolitan Area Planning Council (MAPC) and the city of Boston are both very active in preparing plans for recreational development and conservation of land along the waterfront. The major emphasis of the waterfront plans for these agencies is towards those uses which provide for public enjoyment of the harbor and the preservation of its ecological resources. In 1970, the Massachusetts Legislature created the Boston Islands State Park.

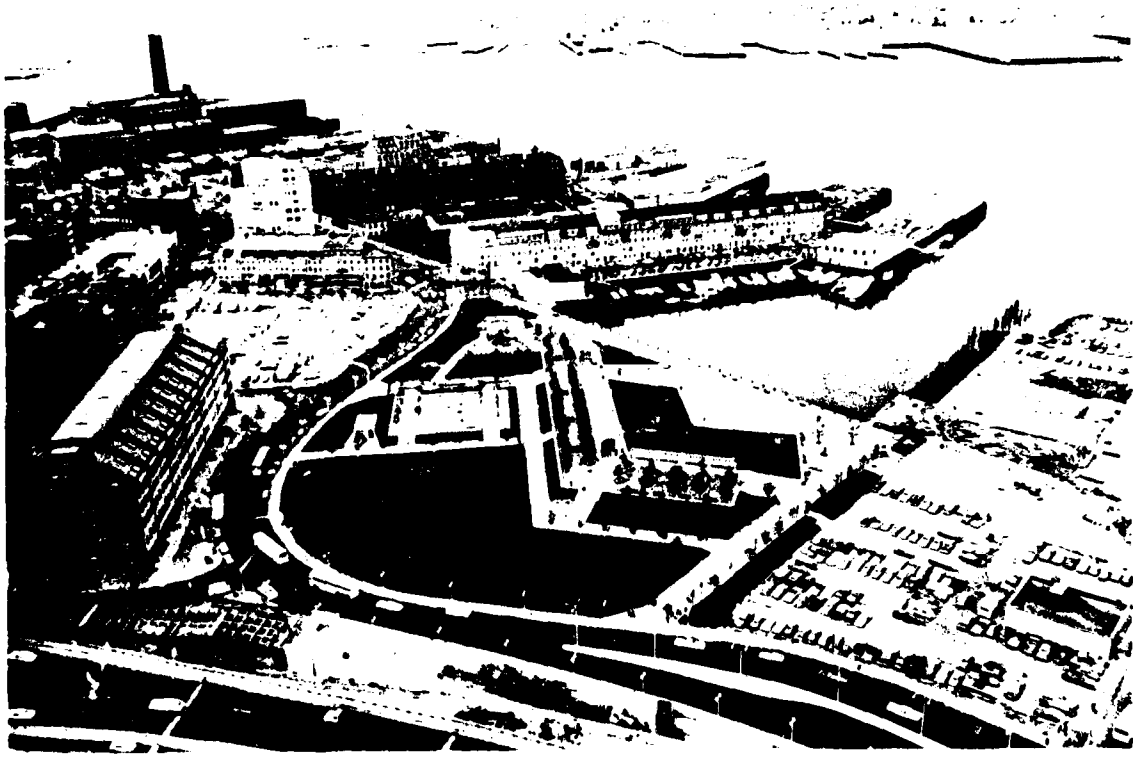


Figure 2. Urban renewal in the North End Waterfront area of Boston. Warehouses and factories have been converted into valuable apartments, shops and offices. A waterfront park has replaced a truck depot. The success of this program may be gauged by the rapid increase in real estate values. Condominiums in Lewis Wharf, in the center of the picture, first sold for $42,000 in 1973, are now offered at $60,000.

Photo courtesy of Boston Redevelopment Authority

In 1976 the Metropolitan Area Planning Council published the Boston Harbor Islands Comprehensive Plan.[3/] Under this plan it is proposed to protect all the harbor islands from undesirable uses and to either develop their potential as historical sites and recreational facilities, or to leave them undeveloped as conservation areas. The plan also envisages turning much of the Outer Harbor waterfront into conservation areas. Other plans for recreational facilities are described in Appendix 1.

Recreational boating is one of the fastest growing outdoor activities in the United States. According to the Boating Almanac, there are twenty marinas offering 1900 slips and 500 moorings around the harbor. In addition, there are 42 yacht and sailing clubs offering moorings and twelve public and private boat launching ramps.[4/] The moored fleet (see Appendix 1, Table B-4) is estimated at 6700 boats, and an average of 800 transients (visiting boats launched from ramps) are estimated to use the harbor daily during the boating season. Figures obtained from the National Association of Engine and Boat Manufacturers (see Appendix 2, Table B-2) indicate that the number of boats registered in the Commonwealth increased at an average exponential rate of 5.58 percent between 1966 and 1976. As the rate of population growth in Boston and the Commonwealth as a whole were approximately equal, it is believed that this rate represents the rate of growth of the harbor fleet. On the basis of the evidence available, it appears likely that the harbor fleet will continue to grow at the present rapid rate for a number of years and then the growth rate will start to decline as moorings come into short supply. This will tend to increase the number of transients launched from ramps, mainly outboards. Further, leisure time will increase both as the proportion of the retired population increases and the working week decreases. This is likely to lead to increased usage of recreational boats.

PROBLEMS AND NEEDS

As previously described, the development of the port and the introduction of new shipping technologies has led to the abandonment and dilapidation of many wharves and waterfront structures. Over 262 have been identified as having deteriorated beyond the stage of economic repair. In addition, there are known to be 55 sunken wooden vessels and 168 concentrations of loose on-shore debris. There are also five shorefront dumps in the study area, all located within the City of Boston.

3/ Boston Harbor Islands Comprehensive Plan, prepared for Massachusetts Department of Natural Resources by the Metropolitan Area Planning Council, October 1972.

4/ Boating Almanac 1977 - Volume 1 Massachusetts, - Maine, - New Hampshire. Boating Almanac Co., Inc.

While these seemingly unauthorized dumps have been identified, located and recorded in this report's inventory of debris sources, Appendix 4, page A-1, the 1977 inventory update found each of these five dump areas no longer to be a potential source of floatable debris. Field examination revealed that each dump is composed of non-floatable material and/or rubbish material and the latter is not considered a hazard to navigation. Therefore, no further consideration has been given to shorefront dumps in this report.

The continual collapse and break-up of these sources leads to polluting the Harbor with floating debris. In addition, tides, currents and winds, coupled with illegal dumping practices, combine to cause debris to move from place to place presenting a serious hazard to navigation. It is estimated that $280,120 was spent on the repair of recreational boats in 1976 as a result of boat/drift collisions (see Appendix 1, Table C-2). In order to substantially reduce this cost of repair to boats, both existing drift and its sources must be removed.

The City of Boston has made major efforts towards urban renewal since 1960. A principal focus has been the redevelopment of the waterfront for residential purposes. While urban renewal is compatible with certain types of active industrial activity, it is incompatible with the presence of numerous dilapidated piers. An example of this is the private rehabilitation of houses for middle class families in the Jeffries Point district of East Boston which overlook the Bethlehem Shipyard to central Boston. On the other hand, the East Boston waterfront between the Massport pier and the Andrew P. McArdle Bridge is an area dominated by derelict structures and all redevelopment which has occured has been government subsidized including the removal of old structures. The removal of debris sources is a necessary step in the redevelopment and renewal of waterfront areas for residential purposes. The removal will provide space and will make the site acceptable, and may be regarded as a site clearance activity. The use of government funds for this activity may make private construction profitable and thus save public financing otherwise necessary for the construction of subsidized housing.

Developing technology has eliminated many waterfront jobs and has created a substantial pool of unemployment among lower income groups who are predominately located in inner city areas. The City of Boston, through its Economic Development and Industrial Commission, is endeavouring to counter this problem by stimulating industry in the City. The industrial redevelopment of the South Boston Navy Yard is one of its major projects. Other mainly smaller industrial communities in the area are faced with the same problems, but do not possess the means of the City of Boston for solving them. Water-front oriented industrial redevelopment requires the removal of derelict structures. Their prior removal would be a considerable stimulus towards such redevelopment. On the other hand, much industrial redevelopment in waterfront areas is not waterfront oriented, and the removal of derelict structures in the Harbor would not provide any benefit to it.

The large amount of drift in the harbor and the presence of derelict structures around it are a major problem. There is a need to remove this drift and its sources in order to improve boating conditions in the harbor. Removal of this hazard to navigation will decrease the potential for boat/drift collisions, thus making the harbor safer for boating enthusiasts. There is also a need to remove derelict structures in order to stimulate redevelopment of the waterfront, particularly for residential purposes. The Commonwealth of Massachusetts received authority in 1971 to clean up state waterways. Some funds have been made available and currently averaging $50,000 annually are awarded for the removal of debris. Most of these funds have been spent on picking up existing floating debris, but very little has been done to remove its sources. Therefore, the program has had little impact on the long term problem. A number of redevelopment projects on the waterfront have already been completed involving the removal of debris sources. However, most of these have been government sponsored and subsidized. Hence, there is still a substantive need for a program to remove debris and debris sources throughout the harbor in a one-time clean-up program.

FORMULATING A PLAN

A two stage screening process was used to select a plan. In the first stage, the plan was screened as to its technical, regulatory and commercial feasibility. In the second stage, each feasible alternative was then evaluated from the standpoints of national economic development (cost-effectiveness), environmental quality, social well-being and regional development.

To formulate a plan of action, the project was divided into three stages: 1) collection, involving the collection of floating debris from the water; 2) removal, involving the removal of sources of debris consisting of dilapidated structures, sunken wooden vessels and piles of shorefront debris; and 3) disposal, which involves the final disposal of the debris collected and removed.

Collection

The method of collection has not been specified so as to allow contractors bidding for the work to select the one most convenient to them.

Removal

Two methods of removal were considered. First, a sea plan operation made up of shallow draft barges carrying track mounted hydraulic 'clamshells' would be utilized, however, land based equipment could also be used where practical. This method has been successfully used for removal of debris from the Liberty State Park area in New York Harbor. Figure 3 shows such a clamshell in operation pulling piles. The second method involves the use of heavy equipment which has to be mounted on deeper draft vessels. Dredging would be required to bring these vessels alongside derelict structures in areas which are silted in and the water is shallow.

Disposal

Eighteen alternative plans for disposal have been considered which can be broken down into the following three groups, namely: 1) destruction by burning; 2) re-use as a source of energy, domestic firewood, woodchips or mulch, hardwood, paper pulp, charcoal, lumber, telephone poles, railroad ties, or pallet construction; or 3) in landfill. These are described in some detail in Appendix 1, Section D.

All the burning alternatives which involve open burning in the project area were rejected because open burning is prohibited by Massachusetts Air Quality Regulations. All reuse alternatives, with the exception of re-use as a source of energy, were rejected since no market or outlet could be found for piles or other timber to be salvaged from the debris. This timber could either be used by a government agency or disposed of in the private salvage market. The Massachusetts Department of Public Works (DPW) has expressed interest in using the debris to manufacture mulch for use on the side of highways. However, this would require special machinery to reduce the debris to chips because it is full of bolts, brackets and other hardware. This special machinery is not proven and the DPW has therefore not made any commitment to accept the debris. The suggestions of placing the debris in an open dump and allowing local people to take it as firewood has also been considered. This would require the provision of land by a local interest and responsibility for final disposal of the debris not removed by the people. The private market for used timber was thoroughly investigated and found to be saturated. No salvage dealers were found who are willing to accept piles or other timber. Salvage markets for re-use of debris are unstable, however, if faced with a positive offer of material some dealer may be willing to devote time and energy to developing a profitable use for the salvaged timber. Reuse is obviously the most desirable method

Figure 3. A Hydraulic "Clamshell" pulling piles.
Photo courtesy Powered Equipment Corp., Newton Highlands

of disposal. Therefore, should a satisfactory method of reuse be developed prior to project implementation it will be considered, and, if appropriate, implemented. Several landfill sites were considered. The only landfill alternative found feasible was the use of an existing landfill in Marshfield.

Selecting A Plan

After first stage screening, eight feasible plans including no action were developed and evaluated. Each of the seven possible implementation plans consists of three stages, namely: collection, removal and disposal. While the collection and removal stages are the same for each plan, the disposal options differ accordingly. These disposal options are described in detail in Appendix 1, Section D and involve the following: burning at sea; incineration at either Saugus or Braintree and using the energy to provide steam for heating and processes at local industries; and the burying of the debris at a private sanitary landfill in Marshfield. Each plan was evaluated as described in Appendix 1, Section D and displayed in tabular form in Appendix 3. Findings indicate that the disposal option of burying the debris at a private sanitary landfill in Marshfield does in fact maximize net benefits. Environmental analysis confirms that action to rid the area of debris would best meet National Economic Development and Environmental Quality goals. Therefore, this plan was selected.

THE SELECTED PLAN

Plan Description

On the basis of the procedure described in the previous section, a plan was selected which includes the following: 1) clearing Boston Harbor of all existing floating debris hazardous to navigation by picking it up; 2) removing all sources of debris consisting of dilapidated waterfront structures, dilapidated portions of partially dilapidated waterfront structures, sunken wooden vessels and loose onshore floatable debris. Removal effort also includes non-floatable materials that form a portion of certain dilapidated structures as well as materials confined in hulls of wrecked vessels; and 3) burying the debris at an existing privately owned sanitary landfill in Marshfield. Debris from the Inner Harbor will be brought via water to a site in South Boston Navy Yard. Debris from the Outer Harbor will be brought via water to Hingham Industrial Center. The debris will then be reduced in size and trucked to Marshfield. The plan also includes the repair of certain partly dilapidated structures that are in use

and warrant repair. The locations of the major facilities are shown on Figure 4. The successful bidder for the cleanup contract will be allowed latitude in selecting removal and disposal methods which do not have any significant negative impact. This is intended to increase competition in bidding.

Evaluated Accomplishments

The following evaluated accomplishments that would result from the proposed plan of improvement are :

a. Improvements to navigation and a substantial reduction in boat/debris collisions in Boston Harbor.

b. The enhancement of waterfront sites, encouraging redevelopment for the economic and social benefit of the local population.

c. Improvements in existing surrounding residential property values, particularly in East Boston.

d. Removal of debris sources will minimize one of the deterrents to the revitalization of the Port of Boston.

Effect On The Environment

The effects on the environment are described in some detail in Appendix 1 and in the Draft Environmental Impact Statement. In summary, the selected plan will not have any significant negative impacts on the environment. The sites selected as staging areas are sufficiently removed from sight so that operations there will not visually intrude on surrounding areas. The Hingham staging area will be visible from the apartments on the opposite side of the Weymouth Back River about 1,500 feet away. This staging area is in a run-down industrial area and therefore will not stand out. Pulling piles and removing debris using a clamshell and shallow draft barges will cause some disturbance to the harbor bottom. Based on experience in New York Harbor, this will be limited to a short-term local increase in turbidity which will not have a significant impact on the marine environment or water quality. The project will produce some noise disturbance due to removal activities near residential areas. Contractors will be

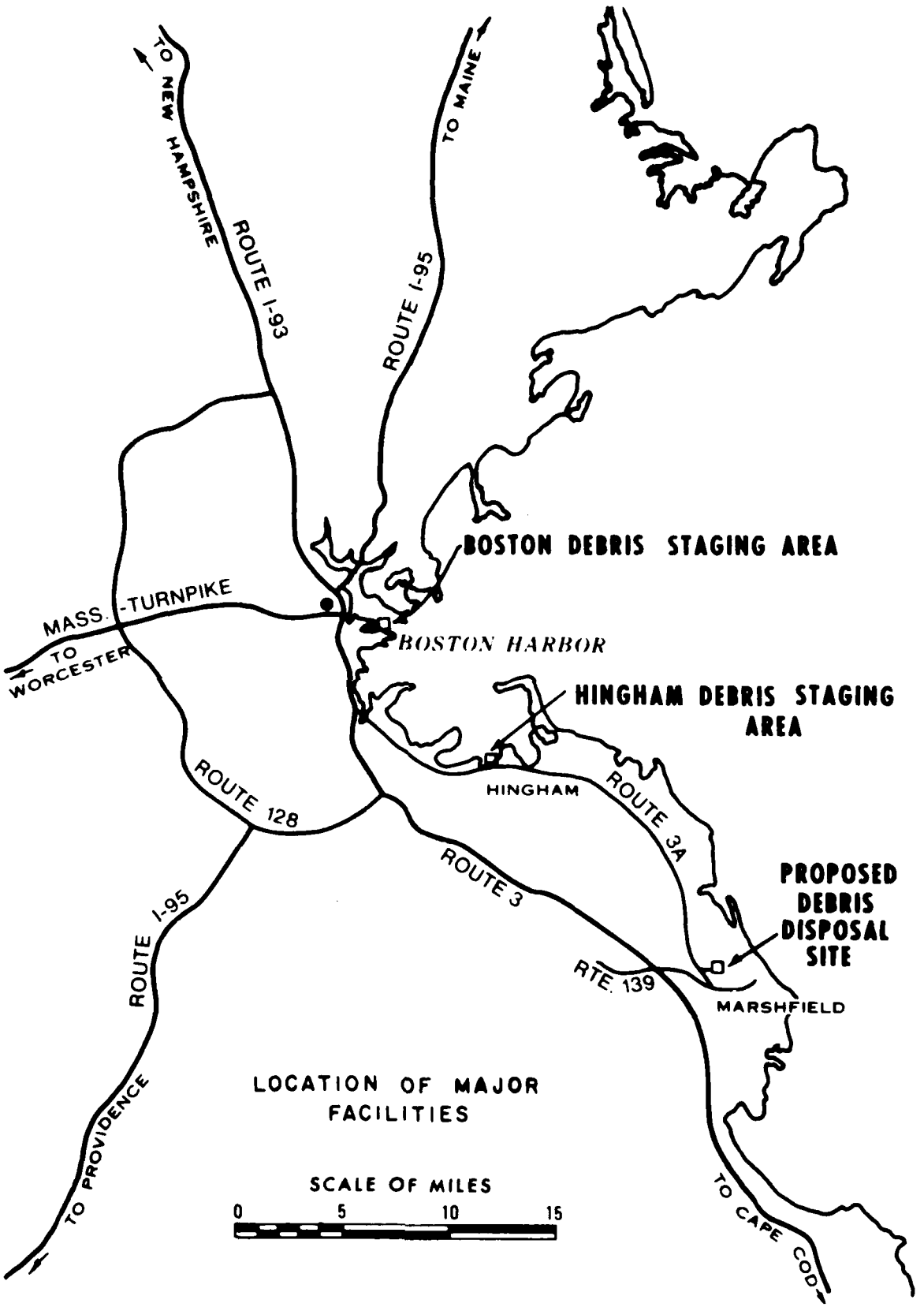

TO NEW HAMPSHIRE
ROUTE I-93
TO MAINE
ROUTE I-95
BOSTON DEBRIS STAGING AREA
MASS. TURNPIKE
TO WORCESTER
BOSTON HARBOR
HINGHAM DEBRIS STAGING AREA
HINGHAM
ROUTE 128
ROUTE 3A
ROUTE 3
PROPOSED DEBRIS DISPOSAL SITE
ROUTE I-95
RTE. 139
MARSHFIELD
TO PROVIDENCE
TO CAPE COD
LOCATION OF MAJOR FACILITIES
SCALE OF MILES
0 5 10 15

FIGURE 4

required to conform to local and state noise regulations. For example, noise levels at the apartments opposite the Hingham staging area are expected to be in the range of 60-65 Decibels, the level of a relatively quiet conversation. The planned level of operation will involve an average total of 6 truckloads of debris per day being carried to the landfill from South Boston for approximately 580 crew-days and from Hingham for approximately 45 crew-days. About 93% of this traffic will be from South Boston. Trucks will be routed along main highways and will avoid local roads to the maximum extent possible. The burying of the debris in a properly managed landfill site is not expected to have any significant impact. The loss of approximately 3 acres of landfill is not considered as significant.

The project will generate significant positive environmental impacts. It will produce a positive impact by removing dilapidated and derelict structures which are a source of floating debris and hence a hazard to navigation. The removal of this hazard to navigation will decrease the potential for boat/drift collisions, thus making the Harbor safer for boats and those people using them. It will produce a positive impact by removing a visual blight from along the shoreline and inducing beneficial redevelopment in certain areas of the waterfront.

The removal of 122 structures within the project area may constitute an adverse effect upon cultural resources if any of these sites are determined eligible for the National Register of Historic Places. If the project proceeds as planned, a cultural resource survey will examine these sites and evaluate them according to the criteria for eligibility for the Register. If any sites are determined eligible, mitigation will be planned in coordination with the Massachusetts Historical Commission and the Advisory Council on Historic Preservation.

ECONOMICS OF SELECTED PLAN

Methodology

The economic justification of the proposed debris removal and disposal was determined by comparing the equivalent annual costs with estimated equivalent annual benefits accruing to the project over its economic life. The average annual benefits should equal or exceed the annual costs if the federal government is to contribute to the project.

Benefits and costs are compared by putting them on an average annual basis at an interest rate of 7 1/8% applicable to public projects.

A number of economic and physical forces limit the life of the project; particularly, the fact that the dilapidated piers and other debris sources would eventually rot away and disappear, and also the inaccuracies in making long term predictions. Based on these factors, an economic life of 50 years was selected for project analysis.

The development of costs and benefits follows standard Corps of Engineers practice. All goods and services used in the development of the project are estimated in monetary terms. Benefits are reflected as navigation benefits and increased property values. Navigation benefits result from a reduction in boat/drift collisions due to cleanup. Increased property values result from a reduction in the cost of future development and from the removal of an unsightly barrier between residential areas and the Harbor (see Appendix 4).

The methodologies and data used to develop these estimates of costs and benefits are described in greater detail in Appendix 1, Section F. and Appendix 2.

Costs

First Costs were estimated for removal, collection and disposal of all existing and potential debris sources as well as the cost of repairing portions of partially dilapidated wharves which are in use. Repairs cover the cost of removal, disposal, and replacement of damaged sections of structures which are partially dilapidated and in use. Where the sound portion only is in use and the damaged portion can be removed without detriment to its continued use, replacement is not included in the estimate. These costs were annualized using a capital recovery factor of .07361, corresponding to an interest rate of 7 1/8% for 50 years. These costs are summarized in Table 2. The costs have been developed with appropriate costs for contingencies, design, and administration of final project construction. Contingencies have been estimated at 20 percent of estimated construction costs. Engineering. design, supervision and administration costs have been estimated using 13 percent of estimated construction costs.

TABLE 2
SUMMARY OF ESTIMATED COSTS
(December 1979)

Removal	$ 9,532,500	
Collection	1,031,100	
Disposal	1,661,900	
Repair of Partially Dilapidated Structures	2,128,800	
Subtotal	$14,354,300	$14,354,300
Contingencies @ 20%		2,871,000
Supervision, Administration, Engineering & Design @ 13%		2,339,000
TOTAL ESTIMATED FIRST COST		$19,464,000
TOTAL ANNUAL COSTS		$ 1,447,700

Benefits

Benefits were determined for both navigation and property improvements. The navigational benefits result from a reduction in the expected number of boat/drift collisions due to cleanup. Property enhancement benefits result from a reduction in the cost of future redevelopment and from the removal of an unsightly barrier between residential areas and the harbor. The benefits were determined by comparing conditions with and without the project.

Navigational benefits were calculated by determining the present costs of repairs to boats resulting from boat/drift collisions and the present size and rate of growth of the recreational fleet. Costs of repair were projected for future years during the project life and discounted at 7 1/8% to obtain a present value. The following are the major inputs and assumptions used to determine navigational benefits:

- 1976 damages due to boat/drift collisions in Boston Harbor are estimated to have cost $280,120.
- By 1980, traffic and damages will have increased 5.5 percent (compounded) annually to $347,000.

(Revised June 1980)

- Boat traffic is predicted to increase at the following compound rates:

1980-1990	5.0%
1990-2000	4.0%
2000-2010	3.0%
2010-2020	2.0%
2020-2030	1.0%
2030-2035	0.0%

- The removal of floating debris and debris sources within the study area is expected to be 90% effective.

Accordingly, the present value of the annual boat damages which would be sustained if this project were not carried out is $9,578,300 This is equivalent to an annualized benefit of $705,000. The method of calculation is described in Appendix 2, Part B.

The reduction in the cost of future development is the future cost of removal and disposal of debris sources where such removal is necessary for redevelopment. Where there are no specific plans for redevelopment, it is assumed that redevelopment will occur either within 20 years of debris removal or on an average of 10 years. Where there are plans for redevelopment, an estimated period of delay in redevelopment is based on the status of the plan. Not all sites will be developed for a use which will require removal of debris sources. Therefore, future land uses are considered individually as shown in Table 3. The expected future use of land was determined from either land use plans or known redevelopment plans for the site.

TABLE 3
TYPE OF DEBRIS REMOVAL REQUIRED FOR REDEVELOPMENT

Land Use	Dilapidated Piers and Piles of Debris	Sunken Vessels
Residential		
w/marina	yes	yes
w/o	yes	no
Commercial	yes	no
Industrial		
waterfront	yes	yes
non-waterfront	no	no
Parks		
w/marina, swimming beach	yes	yes
w/o	yes	no
Conservation Areas	no	no

The present value of the enhancement of property due to the reduction in expected development costs for each affected community is given in Table 4. The total annualized benefit is equivalent to $448,600.

TABLE 4
BENEFIT FROM REDUCTION IN COST OF FUTURE DEVELOPMENT
(Present Worth Values)[1]

	Residential	Recreation[2]	Industrial[3]	Commercial	Total
Hull	$ 53,924	$ 163,820			$ 217,744
Hingham	24,905	775	$ 490,942	$ 4,084	520,706
Weymouth	63,781	470	2,800	2,908	69,959
Braintree			265		265
Quincy	110,228		166,322	8,631	285,181
Boston	1,301,689	1,677,128	1,436,642	40,422	4,455,881
Cambridge			3,179		3,179
Somerville			9,755		9,755
Everett			165,403		165,403
Chelsea	3,468		290,095		293,563
Revere			13,373		13,373
Winthrop	41,572	583		17,727	59,882
Total:	$1,599,567	$1,842,776	$2,578,776	$73,772	$6,094,891

1. 7 1/8% discount rate.
2. Includes Public Open Space
3. Includes Industrial Waterfront Uses and Marinas

The removal of debris sources, particularly dilapidated piers and loose piles of onshore debris, will also eliminate a major eyesore from residential neighborhoods and will increase confidence in the residences values. The harbor was surveyed to determine where the removal of derelict structures will have an impact on surrounding properties. It was judged that this will be significant only in East Boston, where residences abut derelict waterfront areas along a major portion of the shoreline. Here the removal of dilapidated piers will undoubtedly have a major beneficial effect.

These benefits were determined on the basis of two studies, namely; (a) Benefits from Water Pollution Abatement - Property Values and (b) A Generic Methodology to Forecast Benefits from Urban Water Resources Improvement Projects. In addition, in labor market areas which have been designated as redevelopment areas, the Water Resource Council's Principles and Standards directs that the project benefits shall be increased by the value of the local labor required for project construction. These benefits are displayed in Table 5 and the method of calculation is described in detail in Appendix 2, Part B.

TABLE 5

BENEFITS FROM RESIDENTIAL PROPERTY ENHANCEMENT AND AREA EMPLOYMENT

	Present Value	Annualized Benefit
Increased Property Values in East Boston	$4,753,000	$349,800
Area Employment*	1,898,545*	135,400*

The total benefits are displayed in Table 6

TABLE 6

BENEFIT SUMMARY

	Present Value	Average Annual Benefit
Navigational Benefit	$9,578,300	$705,000
Property Enhancement Benefit Reduction in Cost of Future Development	6,094,891	448,600
Existing Residential Property in East Boston	4,753,000	349,800
Reduced Maintenance Cost	-	45,000
Area Employment*	1,898,545*	135,400*
TOTALS:	$20,426,191	$1,548,400

*Under current regulations, Boston no longer qualifies for employment benefits. Consequently, they have not been included in the benefit total.

Justification

The estimated average annual costs and benefits and the ratio of benefits to costs which are shown in Table 7 indicate that the removal, collection and disposal of debris from Boston Harbor is economically justified.

TABLE 7
SUMMARY OF ECONOMIC ANALYSIS

Total Average Annual Costs	$1,447,700
Total Average Annual Benefits (Less Employment Benefits)*	1,548,400
Benefit-Cost Ratio	1.07

*Employment Benefits not currently applicable

DIVISION OF PLAN RESPONSIBILITIES

The U. S. Congress, recognizing the proposed cleanup affects both shorefront urban renewal and water resource improvement work, established a federal cost-sharing formula. As a result, two-thirds of the work cost is to be borne federally and the remaining one-third is assigned to local interests. The cost-sharing applies only to the removal and disposal of derelict vessels, deteriorated shore structures and debris along shorelines when there is no identified owner of the source of the drift or debris. When owners of piers or other potential sources of drift or debris can be identified, the non-federal interests should recover the full cost of the drift or debris removal from the identified owner of these sources. The repair of partly dilapidated structures and the disposal of the unwanted wood material which would be generated from this repair is a local cost item. Partially dilapidated structures where the damaged sections are in use or necessary for the continued use of the structure as a whole are included in this category. Owners of all waterfront structures can and will be identified.

(Revised June 1980)

Table 8 presents a breakdown of the federal and non-federal cost apportionment based on the preceding explanation. Further detail on federal and non-federal responsibilities is included in Appendix 1, Section G.

TABLE 8
1/ APPORTIONMENT OF FIRST COSTS OF SELECTED PLAN

DESCRIPTION	TOTAL COST	FEDERAL SHARE	NON-FEDERAL SHARE
Work for Removal of Derelict Wooden Vessels Loose On-shore Debris and Floating Drift	3,922,000	2,615,000	1,307,000
Work for Removal Dilapidated Shore Structures	12,655,000	0	12,655,000
Work for Repair of Partially Dilapidated Shore Structures	2,887,000	0	2,887,000
Total for the Selected Plan	19,464,000	2,615,000	16,849,000

1/ Cost apportionment is subject to adjustment based on the number of identified owners of drift and debris sources at time of project implementation.

PLAN IMPLEMENTATION

A brief description of the steps that would be necessary to implement the plan of improvement for debris removal from Boston Harbor, as reported herein, can be summarized as follows:

The report would be reviewed by the New England Division of the Corps of Engineers; the Board of Engineers for Rivers and Harbors; and the Office of the Chief of Engineers. The Chief of Engineers would transmit the report to the Governor of Massachusetts and other interested federal agencies for formal review and comment. Following the above state and interagency review, the final report of the Chief of Engineers would be forwarded to the Secretary of the Army who would obtain the views and comments of the Office of Management and Budget and then transmit the report to Congress.

The Committees of Public Works of the House and Senate would hold hearings on the report with a view toward formulating a bill including the authorization of the recommended project. If the project is authorized, the Chief of Engineers would then have to include funds for design and construction in his budget requests.

"Upon appropriations of funds for design and construction, detailed plans, specifications, and cost estimates for each individual project element will be developed. Included in this effort would be a property ownership survey to identify, where applicable, the owners of piers or other potential sources of drift or debris that are to be collected and removed as part of this project. The results of this survey will be used to determine the final cost-sharing for the project in accordance with Section 202 (c) of the Water Resource Development Act of 1976. At this time, the formal assurances of local cooperation would be required. Bids would then be invited and contracts awarded."

It is not possible to forecast the exact time frame for the completion of the above steps. However, once the improvements are authorized and initially funded by Congress, it would be possible to complete the design and construciton of them within four years, if subsequent appropriations were funded as required.

VIEWS OF NON-FEDERAL INTERESTS

Workshops were held with the Massachusetts Department of Environmental Quality Engineering and the Office of Coastal Zone Management of the Governor's Executive Office of Environmental Affairs.

On 29 September 1977, a formulation stage public meeting was held in Boston to present the preliminary findings concerning the study. State and local officials present gave overwhelming support for the plan selected and the only adverse comments concerned delays in implementation. Among the Massachusetts dignitaries endorsing it were the following: Governor Michael S. Dukakis, Lt. Governor Thomas P. O'Neill, III, Edward I. Moore, Administrative Assistant to Congressman James A. Burke, State Senator William M. Bulger, State Representative Caroline Stouffer, State Representative Michael Morrissey and David Standley, Commissioner of Mass. Department of Environmental Quality Engineering.

Each of the 12 affected communities, by letter, have endorsed the selected plan and indicated a willingness to cooperate as required. These letters are contained in Appendix 7. There has been no major criticism of the project. Several interests have suggested review of disposal alternatives. This will be done in post authorization studies. Governor King, by letter of 1 November 1979, strongly supports the project. However, he does believe the Commonwealth is being required to bear a disproportionate share of project costs. Accordingly, he plans to pursue those administrative and legislative measures necessary to alter the proposal cost sharing arrangement.

VIEWS OF FEDERAL INTERESTS

Coordination of the Draft Feasibility Report and Draft Environmental Impact Statement was accomplished with the following agencies:

Environmental Protection Agency

Department of Interior

U.S. Fish and Wildlife Service

Department of Housing and Urban Development

National Ocean and Atmospheric Administration

U.S. Coast Guard

Each of those responses concerning environmental matters have been included in the final Environmental Impact Statement along with Corps' comments . In general, the agencies supported the goals of the project. Significant statements are summarized below. These letters are included in Appendix 7.

- The Environmental Protection Agency had reservations about the proposed Marshfield Disposal Site and the possible effects on the surrounding water quality.

- U.S. Fish and Wildlife showed some concern for the biological resources which would be affected by debris removal, as well as removal methods for debris located in salt marshes and tidal flats.

- The Department of Interior referenced previous U.S. Fish and Wildlife Service letters concerning use of and/or reconstruction of piers for recreational fishing. Also, close coordination was requested with the National Park Service and Boston Redevelopment Authority during their planning for the development, preservation, and reuse of the recently closed Charlestown Navy Yard.

- The U.S. Coast Guard addressed the legality of fender removal around certain bridge abutments in the harbor.

SUMMARY

Boston Harbor has been subjected to many changes in waterfront land uses during its long history. In recent times, the introduction of modern methods of handling cargo has led to the concentration of port facilities into a few specialized sites. This has resulted in large scale abandonment of waterfront structures. Furthermore, over the years many wooden vessels have sunk and been abandoned and piles of debris have accumulated on the shorefront. The gradual disintegration of these structures has contributed to a considerable accumulation of floating debris in the harbor which is a hazard to navigation.

It is estimated that the cost of repair of recreational boats due to boat/drift accidents in 1977 was $280,120, and that this annual cost will rise to about $1,440,800 by 2035 if the drift and its sources are not removed. The abandoned and derelict structures lining the Inner Harbor are also visually unattractive and even threatening. Their removal is a necessary step for the redevelopment of prime waterfront areas as part of the urban renewal program for the City of Boston.

The project involves the collection of floating debris, the removal of dilapidated piers and waterfront structures, sunken wooden vessels, and shorefront piles of debris. The final disposal of these materials is to be in a privately operated sanitary landfill in Marshfield, Massachusetts. The project does not have any significant negative impacts on the environment, but does have many positive ones. These include substantial reduction in the number of boat/drift collisions, thereby protecting the boating public; increased potential for recreational boat development and related shore facilities; improved aesthetics; and enhanced economic development within the study area.

The work would be carried out by the United States Government after congressional authorization and funding and after receipt of the non-federal share of the cost. The presently estimated federal share of the cost of improvement is $2,583,000 and the estimated nonfederal cost is $16,881,000. (This does not reflect the President's proposed Water Policy.)

A condition of federal participation is that local interests must take responsibility for preventing the further accumulation of debris sources and must maintain the harbor free from significant quantities of floating debris. The plan of improvement is acceptable to local interests.

A summary of economic data for the proposed plan is shown in the following table:

TABLE 9
SUMMARY OF ECONOMIC DATA, BOSTON HARBOR, THE SELECTED PLAN

		First Cost/Benefit	Annual Cost/Benefit
Costs: **	Collection	$ 1,398,000	
	Removal	12,926,000	
	Disposal	2,253,000	
	Repair of Structures	2,887,000	
	Total Cost	19,464,000	$1,447,700
Benefits:	Reduction in Boat Damage	$ 9,578,300	$ 705,000
	Improvement in Property Values	10,847,891	798,400
	Reduction in Maintenance cost to MA.		45,000
	Total Benefits *	$20,426,191	$1,548,400
Benefit/Cost Ratio 1.07			

*Employment benefits excluded
**Includes 20% contingencies and 13% E&D and S&A charges

STATEMENT OF FINDINGS

In accordance with Public Law 94-587 Oct. 22, 1976, Section 202 (a), the Congress determined that drift and debris on or in publicly maintained commercial boat harbors and the land and water areas immediately adjacent thereto threaten navigational safety, public health, recreation and the harborfront environment.

The selected plan for the improvement of Boston Harbor, Massachusetts reflects a combination of Corps' planning and public involvement. Information was obtained from federal, state and local officials regarding problems identification and planning objectives, formulation of alternatives, and evaluation of impact assessments of the various alternatives considered for formulation of the selected debris collection, removal and disposal plan.

(Revised June 1980)

The possible consequences of all reasonable alternatives have been studied and evaluated according to engineering feasibility, environmental quality, social well-being and economic factors including regional and national development. The study has been conducted according to criteria set forth by Water Resources Council Principles and Standards.

Pertinent consideration in the selection of the plan of improvement for Boston Harbor, Massachusetts were as follows:

a. Engineering Considerations - A technically feasible and cost effective method of operation was selected. The method of removal has been tried and proved out in a similar project in New York Harbor by the debris removal contractors. The method of disposal is the least costly among the alternatives investigated.

b. Environmental Considerations - The proposed project does not have any significant negative environmental impacts with the exception of possible adverse impacts upon archaeological-historical features. These impacts will be assessed more fully if the project is implemented at the next level of study. The project has positive impacts in terms of improvements in recreational opportunities and aesthetics concerning the Harbor.

c. Economic Considerations - The proposed plan will induce beneficial redevelopment of waterfront properties and enhance surrounding areas, and generate significant navigation savings resulting from the reduction in boat/drift collisions thus promoting economic well-being in terms of employment and commerce.

d. Social Considerations - The proposed plan will not only improve conditions in many residential areas surrounding the Inner Harbor, but will also assist in urban renewal programs for reversing the decline of inner city areas; hence, promoting the social well-being of the local people.

In accordance with guidelines outlined in the Water Resource Council on Principles and Standards, alternative plans were developed which would maximize the National Economic Development and Environmental Quality Accounts. Plan 8 was selected as best at this time. Each possible implementation plan consists of three debris tasks; namely, collection, removal and disposal. Findings indicate that only the disposal options differ. Consequently, alternative plans 3, 4, 6, and 7 of the seven action alternatives explained in detail in Appendix 1, Section D are merely variations of the least costly three alternative plans (2, 5 and 8) displayed in Table 10, "Summary Comparison of Final Alternative Plans." These variations concern debris transfer operations only and form part of the disposal task. Furthermore, evaluation of these four is not considered necessary since it would only serve to echo information displayed in Table 10.

It is concluded that the action, as proposed in the recommendations section of this report, is based on thorough analysis and evaluation of various practicable alternative courses of action for achieving the stated objectives; that wherever adverse effects are found to be involved, they cannot be avoided by following reasonable alternatives which will achieve the Congressionally specified purposes of the recommendation; that the recommended action is consonant with national policy, statutes, and administrative directives; that where the proposed action has an adverse effect, this effect is either ameliorated or substantially outweighed by other considerations of national policy; and that on balance the total public interest should best be served by its implementation.

TABLE 10 SUMMARY COMPARISON OF FINAL ALTERNATIVI
BOSTON HARBOR, MASSACHUSETTS

ALTERNATIVES	PLAN 1 No action	PLAN 2 Collection and removal and d by burning at sea.
A. PLAN DESCRIPTION		
1. Major Features	.Allow blight to persist .Hazard to navigation to worsen .Ignore the increasing menace debris causes to people's health and safety .Allow prime waterfront land to go unused	.Pick up drift via boat .Demolish and remove debris .Haul debris via barge to Bc site and stockpile .Transfer debris to burn ves .Tow vessel 20 miles to sea .Return burnt residue, as ne a landfill
2. Land Required		
a. Temporary	a. N/A	a. 10 acres at Boston trai
b. Permanent	b. N/A	b. None
B. IMPACT ASSESSMENT		
1. Social Effects - (SWB)		
a. Aesthetic Values	a. Allow visual blight due to debris to continue	a. Enhance visual appearai harbor at debris sites

ISON OF FINAL ALTERNATIVE PLANS
HARBOR, MASSACHUSETTS

PLAN 2	PLAN 5	PLAN 8
lection and removal and disposal burning at sea.	Collection and removal and disposal by burning in an incinerator	Collection and removal and disposal in a sanitary landfill
ck up drift via boat	.Same as Plan 2	.Same as Plan 2
molish and remove debris sources	.Same as Plan 2	.Same as Plan 2
ul debris via barge to Boston land te and stockpile	.Haul debris via barge to both Boston and Hingham land sites and stockpile	.Same as Plan 5
ansfer debris to burn vessel		
w vessel 20 miles to sea and burn	.Reduced in size at transfer site	.Same as Plan 5
turn burnt residue, as needed, to landfill	.Load onto trucks, haul to, process at and burn in Braintree incinerator	.Load onto trucks, hauled to and deposited in private landfill in Marshfield
. 10 acres at Boston transfer site	a. Same as Plan 2	a. Same as Plan 2
--	10 acres at Hingham transfer site	Same as Plan 5
. None	b. None	b. 3 acres
. Enhance visual appearances of harbor at debris sites	a. Same as Plan 2	a. Same as Plan 2

TABLE 10 SUMMARY COMPARISON OF FINAL ALTERNATIV
BOSTON HARBOR, MASSACHUSETTS

ALTERNATIVES	PLAN 1 No Action	PLAN 2 Collection and removal and di by burning at sea
b. Life, safety, and health	b. 1. Increasing threat to life safety and health of recreational boaters utilizing the harbor 2. Continuing threat to life, safety and health of neighborhood children in debris located areas	b. 1. Reduction in threat to recreational boaters 2. Reduction in threat to neighborhood children debris located areas
2. Economic - (NED-RD)		
a. Property Values	a. Property values near debris sites will continue to be depressed	a. Property values near debri sites will rise
b. Desireable Community Growth	b. Drag on desireable community growth near debris sites	b. Encourages desireable co growth near debris sites
3. Environmental Effects (EQ)		
a. Man made resources*	a. Continued deterioration of already dilapidated structures	a. Dilapidated structures an wrecked vessels eliminate conserves man made resour reducing the number of bo drift collisions and by r ing rather than replacing tain damaged waterfront structures
b. Air Quality*	b. N/A	b. Release of large quantiti pollutants into the air d burn

PARISON OF FINAL ALTERNATIVE PLANS
STON HARBOR, MASSACHUSETTS

PLAN 2	PLAN 5	PLAN 8
ollection and removal and disposal y burning at sea	Collection and removal and disposal by burning in an incinerator	Collection and removal and disposal in a sanitary landfill
1. Reduction in threat to recreational boaters	b. 1. Same as Plan 2	b. 1. Same as Plan 2
2. Reduction in threat to neighborhood children in debris located areas	2. Same as Plan 2	2. Same as Plan 2
. Property values near debris sites will rise	a. Same as Plan 2	a. Same as Plan 2
. Encourages desireable community growth near debris sites	b. Same as Plan 2	b. Same as Plan 2
. Dilapidated structures and wrecked vessels eliminated conserves man made resources by reducing the number of boat-drift collisions and by repairing rather than replacing certain damaged waterfront structures	a. Same as Plan 2	a. Same as Plan 2
. Release of large quantities of pollutants into the air during burn	b. Minor	b. None

TABLE 10 SUMMARY COMPARISON OF FINAL ALTERNAT
BOSTON HARBOR, MASSACHUSETT

ALTERNATIVES	PLAN 1 No action	PLAN 2 Collection and removal and di by burning at sea
c. Water Quality*	c. N/A	c. Minor local increases in t bidity and release of heav metals during collection a removal. Some pollutants etc.) will fall into the o during burn
d. Water Cleanliness	d. No improvement	d. Improved due to removal of debris
e. Natural Resources*	e. N/A	e. Displacement or destructio small numbers of organisms living on or around the wr age or piers to be removed
f. Habitats	f. N/A	f. Destruction of habitats of those organisms living on wreckage or piers to be re moved. Only potentially serious impacts would be o common tern

COMPARISON OF FINAL ALTERNATIVE PLANS
BOSTON HARBOR, MASSACHUSETTS

PLAN 2	PLAN 5	PLAN 8
ollection and removal and disposal y burning at sea	Collection and removal and disposal by burning in an incinerator	Collection and removal and disposal in a samitary landfill
Minor local increases in turbidity and release of heavy metals during collection and removal. Some pollutants (ash, etc.) will fall into the ocean during burn	c. Minor local increases in turbidity and release of heavy metals during collection and removal	c. Same as Plan 5
Improved due to removal of debris	d. Same as Plan 2	d. Same as Plan 2
Displacement or destruction of small numbers of organisms living on or around the wreckage or piers to be removed	e. Same as Plan 2	e. Same as Plan 2
Destruction of habitats of those organisms living on the wreckage or piers to be removed. Only potentially serious impacts would be on common tern	f. Same as Plan 2	f. Same as Plan 2

TABLE 10 SUMMARY COMPARISON OF FINAL ALTERNA
BOSTON HARBOR, MASSACHUSETT

	PLAN 1	PLAN 2	
ALTERNATIVE	No action	Collection and removal and dis by burning at sea	
C. PLAN EVALUATION		BENEFICIAL	ADVERSE
1. Contributing of NED and EQ Planning Objectives			
a. Property Enhancement	a. N/A	a. -Reduce the cost of site redevelopment -Increase property values -Generate confidence in future development	
b. Increase Recreational Boating	b. Unlikely	b. -Reduction in boat-drift collisions and related repair costs	
c. Encourage Harbor Development	c. Unlikely	c. -Promote redevelopment at sites	
d. Encourage Rehabilitation	d. Unlikely	d. At some sites	
e. Energy Source	e. Not Available	e. None	

COMPARISON OF FINAL ALTERNATIVE PLANS
BOSTON HARBOR, MASSACHUSETTS

PLAN 2		PLAN 5		PLAN 8	
llection and removal and disposal burning at sea		Collection and removal and disposal by burning in an incinerator		Collection and removal and disposal in a sanitary landfill	
BNEFICIAL	ADVERSE	BENEFICIAL	ADVERSE	BENEFICIAL	ADVERSE
• -Reduce the cost of site redevelopment -Increase property values -Generate confidence in future development		a. -Same as Plan 2 -Same as Plan 2 -Same as Plan 2		a. -Same as Plan 2 -Same as Plan 2 -Same as Plan 2	
). -Reduction in boat-drift collisions and related repair costs		b. -Same as Plan 2		b. -Same as Plan 2	
:. -Promote redevelopment at sites		c. -Same as Plan 2		c. -Same as Plan 2	
l. At some sites		d. -Same as Plan 2		d. -Same as Plan 2	
. None		e. Burning of approximately 3.2 million cubic feet of debris could conserve about 28,000 tons of coal equivalent fossil fuels		e. None	

TABLE 10 SUMMARY COMPARISON OF FINAL ALTERNA
BOSTON HARBOR, MASSACHUSETT

ALTERNATIVES	PLAN 1 No action	PLAN 2 Collection and removal and dis by burning at sea
2. Net Effects		
a. NED	a. N/A	a. $858,600 more than Plan 8
b. EQ	b. N/A	b. Plan implementation would n involve any significant tra offs
c. SWB	c. N/A	c. Plan implementation would involve any significant tr offs
d. RD	d. N/A	d. Plan implementation would n involve any significant tra offs
3. Plan Response To:		
a. Acceptability	a. No	a. No, some interests oppose open burning at sea
b. Completeness	b. No	b. Yes, no further investment required
c. Effectiveness & Efficiency	c. No	c. No, air quality standards would be compromised. Th plan is more costly than Plan 8

COMPARISON OF FINAL ALTERNATIVE PLANS
BOSTON HARBOR, MASSACHUSETTS

PLAN 2		PLAN 5	PLAN 8
lection and removal and disposal burning at sea		Collection and removal and disposal by burning in an incinerator	Collection and removal and disposal in a sanitary landfill
$858,600 more than Plan 8	a.	$1,585,000 more than Plan 8	a. Least costly
Plan implementation would not involve any significant trade-offs	b.	Same as Plan 2	b. Same as Plan 2
Plan implementation would not involve any significant trade offs	c.	Same as Plan 2	c. Same as Plan 2
Plan implementation would not involve any significant trade offs	d.	Same as Plan 2	d. Same as Plan 2
No, some interests oppose open burning at sea	a.	Yes, local support	a. Yes, strong local support
Yes, no further investments required	b.	Yes, same as Plan 2	b. Yes, same as Plan 2
No, air quality standards would be compromised. This plan is more costly than Plan 8	c.	Yes, however this plan is more costly than Plan 8	c. Yes, this plan has been tested and proven

TABLE 10 SUMMARY COMPARISON OF FINAL ALTERN
BOSTON HARBOR, MASSACHUSET

ALTERNATIVES	PLAN 1 No action	PLAN 2 Collection and removal and dis posal by burning at sea
d. Certainty	d. No	d. No, state law could prohib burn at sea
e. Geographic Scope	e. No	e. Study area totally contain impacted geographic region
f. NED B/C Ratio	f. N/A	f. 1.12
g. Stability	g. N/A	g. High stability

COMPARISON OF FINAL ALTERNATIVE PLANS
BOSTON HARBOR, MASSACHUSETTS

PLAN 2	PLAN 5	PLAN 8
llection and removal and dis-sal by burning at sea	Collection and removal and disposal by burning in an incinerator	Collection and removal and disposal in a sanitary landfill
No, state law could prohibit burn at sea	d. No, incinerator lacks the capability to reduce the size of debris for burning	d. Yes
Study area totally contains impacted geographic region	e. Same as Plan 2	e. Same as Plan 2
1.12	f. 1.08	f. 1.18
High stability	g. High stability	g. Greatest stability

TABLE 10 SUMMARY COMPARISON OF FINAL ALT
BOSTON HARBOR, MASSACHU

	PLAN 1	PLAN 2
ALTERNATIVES	No action	Collecti on and removal and di by burning at sea
D. IMPLEMENTATION RESPONSIBILITY		
		a. Same as Plan 8
		b. Same as Plan 8
	N/A	a. Same as Plan 8
		b. Same as Plan 8
		c. Same as Plan 8
		d. Same as Plan 8

RY COMPARISON OF FINAL ALTERNATIVE PLANS
BOSTON HARBOR, MASSACHUSETTS

PLAN 2	PLAN 5	PLAN 8
llection and removal and disposal burning at sea	Collection and removal and disposal by burning in an incinerator	Collection and removal and disposal in a sanitary landfill
		FEDERAL
a. Same as Plan 8	a. Same as Plan 8	a. Provide 2/3 of the cost for the removal and disposal of debris sources, from unidentified owners.
b. Same as Plan 8	b. Same as Plan 8	b. Prepare, offer for bid and award contracts and supervise all project work
		NON-FEDERAL
a. Same as Plan 8	a. Same as Plan 8	a. Contribute 1/3 of the cost for the removal and disposal of debris sources from unidentified owners.
b. Same as Plan 8	b. Same as Plan 8	b. Provide, without cost to the United States, all lands, easements and rights-of-way
c. Same as Plan 8	c. Same as Plan 8	c. Hold and save the United States free from damages that may result from the considered improvements, and from any subsequent maintenance work
d. Same as Plan 8	d. Same as Plan 8	d. Enact and enforce legislation prior to completion of the project to prevent creation of future sources of drift and debris, estimated to cost $15,000 annually.

TABLE 10 SUMMARY COMPARISON OF FINAL ALTERNATIVE
BOSTON HARBOR, MASSACHUSETTS

	PLAN 1	PLAN 2
ALTERNATIVES	No action	Collection and removal and disp by burning at sea
		e. Same as Plan 8
		f. Same as Plan 8
	N/A	
		g. Same as Plan 8
		h. Same as Plan 8

ISON OF FINAL ALTERNATIVE PLANS
HARBOR, MASSACHUSETTS

PLAN 2	PLAN 5	PLAN 8
ection and removal and disposal urning at sea	Collection and removal and disposal by burning in an incinerator	Collection and removal and disposal in a sanitary landfill
Same as Plan 8	e. Same as Plan 8	e. Provide a written commitment to the use of the transfer and disposal sites as proposed and to provide suitable alternative sites should the planned sites become unavailable for any reason prior to construction of the project
Same as Plan 8	f. Same as Plan 8	f. Make necessary repairs to deteriorated structures in use satisfactory to the Chief of Engineers so as to eliminate them as a source of drift. The work will be performed simultaneously with the work to be performed by the Federal Government for the considered improvement
Same as Plan 8	g. Same as Plan 8	g. Comply with the requirements of non-federal cooperation as specified in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646
Same as Plan 8	h. Same as Plan 8	h. Contribute 100% of the cost for removal of drift and debris which is attributable to an identifiable owner.

RECOMMENDATION

The Division Engineer recommends that the selected cleanup plan for Boston Harbor be implemented to provide for the removal and disposal of dilapidated waterfront structures (primarily timber pile supported wharves and bulkheads) deteriorated sections of partly dilapidated structures, derelict (wrecked) vessels and loose floatable debris lying on dilapidated structures and onshore drift, with such modifications as in the discretion of the Chief of Engineers may be advisable, at a first cost presently estimated at $19,464,000 (December 1979 price levels).

Regarding project costs, the President in his June 1978 water policy message, and in a more recent (May 1979) legislative proposal to Congress, proposed several changes in cost sharing for water resources projects to allow states to participate more actively in project implementation decisions. These changes include a cash contribution from benefiting states of 5 percent of first costs of construction assigned to nonvendible project purposes and 10 percent of costs assigned to vendible project purposes. Application of this policy to the Boston Harbor Debris project would require a contribution from the Commonwealth of Massachusetts of an estimated $973,000 in cash (5 percent of the $19,464,000 total estimated project first costs assigned to nonvendible project purposes, based on December 1979 price levels).

This cash contribution would not be required until immediately prior to project construction and would be in addition to any other non-Federal costs required by current legislation and regulations for project implementation. The total Federal estimated share of the first cost of the recommended plan of improvement excluding the President's proposed cost-sharing policy would be $1,642,000 representing about 8 percent of the total first cost. (In absence of that policy, it would be $2,615,000.) The Commonwealth of Massachusetts commented on the President's proposed cost-sharing policy by letter of 1 November 1979. The added funding distribution, that is: a cash contribution of 5 percent of the first cost of construction, is not supported by the Commonwealth. It is recommended that construction authorization be in accordance with the President's proposed cost-sharing policy.

Recommendations are subject to approval by higher Federal authority and to the conditions that local interests will:

(1) Provide, without cost to the United States, all lands, easements and rights-of-way required for construction and future maintenance of the project.

(2) Hold and save the United States free from damages due to the construction or maintenance of the project, except those damages which are attributable to the fault or negligence of the Government or its

contractor; and hold and save the United States free from any damages which may result from the Commonwealth of Massachusetts' performance, or failure to perform, any of its required responsibilities for the project.

(3) Enact and enforce legislation prior to completion of the project to prevent the creation of future sources of drift and debris. Annual cost of a local inspection program has been estimated at $15,000. (See page F-3, Appendix 1 for details.)

(4) Provide the transfer and disposal sites as proposed including suitable access thereto, or in the alternative provide other sites should the planned sites become unavailable for any reason prior to construction of the project.

(5) In accordance with Section 202, Public Law 94-587, (90 Stat. 2917), 33 U.S.C.A. 426 m:

(a) Contribute a cash payment of 1/3 of the first cost for removal of drift and debris which cannot be attributed to an identifiable owner, a sum presently estimated at $1,307,000.

(b) Contribute a cash payment of 100% of the first cost for removal of drift or debris which is attributable to an identifiable owner, a sum presently estimated at $12,655,000.

(c) Pay its required contributions in a lump sum prior to commencement of project construction or in installments prior to commencement of pertinent work items, in accordance with construction schedules as required by the Chief of Engineers. The final apportionment of cost will be made after actual costs and values have been determined.

(6) Make necessary repairs to deteriorated waterfront structures in use which are potential sources of drift, the cost of which is presently estimated at $2,887,000. The repairs will be performed simultaneously with the work performed by the Federal Government on the project. The material removed in connection with the repairs may be disposed of at no cost to the Federal Government in the facilities provided to the Federal Government for the project.

(7) Comply with the requirements of non-Federal cooperation as specified in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646.

MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

ACKNOWLEDGEMENTS

1. The preparation of this report was administered by:

Max B. Scheider, Colonel, Corps of Engineers,
Division Engineer

John P. Chandler, Colonel, Corps of Engineers(Retired),
former Division Engineer

Joseph L. Ignazio, Chief, Planning Division

2. The planning was directed by Oscar E. Arpin during his tenure as Chief, Coastal Development Branch and Donald W. Martin, his successor. Plan formulation and study management was directed by Raymond J. Boyd. Social and Economic Analysis was prepared under the direction of Steven Rubin, Chief, Economic and Social Analysis Section. The Environmental Impact Statement was prepared under the direction of William McCarthy, Chief, Impact Analysis Branch.

3. Louis Berger Associates, Inc., Architects, Engineers and Planners prepared under contract to the Corps of Engineers, New England Division, the Draft Feasibility Report and Draft Environmental Impact Statement, dated July 1978.

4. The Legal Appendix was done by Joseph DiGiovanni and Gerald Kelley of the Office of Counsel, New England Division, Corps of Engineers, under the direction of Raymond McCulloch, Division Counsel.

BOSTON HARBOR, MASSACHUSETTS

FEASIBILITY REPORT

FOR DEBRIS REMOVAL

Technical Report

SECTION A - THE STUDY AND REPORT
SECTION B - RESOURCES AND ECONOMY OF STUDY AREA
SECTION C - PROBLEMS AND NEEDS
SECTION D - FORMULATING A PLAN
SECTION E - THE SELECTED PLAN
SECTION F - ECONOMICS OF SELECTED PLAN
SECTION G - DIVISION OF PLAN RESPONSIBILITIES

APPENDIX 1

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

DECEMBER 1979
(REVISED MAY 1980)

SECTION A

THE STUDY AND REPORT

THE STUDY AND REPORT

TABLE OF CONTENTS

LIST OF FIGURES

The Study and Report

1. The information presented in this section serves as an introduction to the study, its scope and findings and to their presentation in the report.

Purpose and Authority

2. The purpose of the study is to determine the engineering feasibility and economic justification for federal participation in a one-time cleanup program to rid the area of its sources of floatable debris such as dilapidated shorefront structures, derelict (wrecked) vessels and loose onshore debris and to halt the flow of debris from shorefront dumps. An additional purpose is to determine the adequacy or inadequacy of existing governmental laws to cope with these debris problems.

3. This report is submitted in response to a resolution adopted 18 March 1966 by the Committee on Public Works of the United States Senate, which reads as follows:

> "RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, that the Board of Engineers for Rivers and Harbors is hereby requested to review the reports of the Chief of Engineers on Boston Harbor, Massachusetts, published as House Document 225, Seventy-sixth Congress, 1st Session, and other reports, with a view to determining the advisability of eliminating the sources of drift and debris and other obstructions and injurious deposits that pollute the water of Boston Harbor, by removal and disposal of dilapidated structures and derelicts, and by other appropriate measures, along the shores of the harbor, and its tributary waters, that constitute possible obstacles or hazards, or produce damages to existing navigation."

Scope of the Study

4. This study covers the area of Boston Harbor and its tributary waters. Twelve communities abut the harbor, proceeding clockwise from the south, these are: towns of Hull, Hingham, Weymouth, and Braintree; cities of Quincy, Boston, Cambridge, Somerville, Everett, Chelsea and Revere; and the town of Winthrop. The study area is shown on Figure A-1.

5. The depth and detail of the study are commensurate with the objective of selecting the most suitable plan of development and determining its feasibility, giving consideration to the economic, environmental and social factors for each of the affected shore-front communities and Boston Harbor. The division of responsibilities between federal and non-federal interests have also been determined.

The Report

6. This report has been arranged into a main report and seven appendices.

7. The main report is a non-technical presentation of regional and local problems including the needs and effects associated with the removal and disposal of debris from Boston Harbor. Included in the main report are the following: a description of the study area and the present status of debris removal and disposal in Boston Harbor; the needs for removing and disposing of debris from the harbor and methods involved in formulating and selecting a plan for meeting the needs; a comprehensive description of the selected plan and its effects; a summary of the project economics indicating the benefits, costs, and justification; the division of project responsibility between federal and non-federal interests; coordination information and recommendations for implementing the selected plan.

8. Appendix 1 is a section of a technical report following the same general outline as the main report, but in greater detail for the technical reviewer. It examines the problems and solutions in the same order as the main report, but excludes subsequent plan implementation, coordination and recommendation material.

9. Appendix 2 forms a part of the technical report which details the analysis underlying the benefit and cost estimates.

10. Appendix 3 contains a display of alternative plan effects as prescribed in the Water Resource Council's "Principles and Standards for Planning Water and Related Land Resources."

11. Appendix 4 contains the debris inventory by community including summary sheets and the land enhancement summary sheets.

12. Appendix 5 contains the Draft Cultural Resource Reconnaissance prepared in compliance with the Corps' responsibilities under the National Historic Preservation Act of 1966 (PL-89-665) and related legislation.

13. Appendix 6, a Legal Section, contains a compilation and review of existing federal, state and local governmental laws and studies to determine their adequacy or inadequacy to correct the debris problem with recommendations within the study area.

14. Appendix 7, pertinent correspondence, includes the comments and views of federal, state and local agencies which have expressed an interest in the study.

15. In addition, the "Draft Environmental Impact Statement", prepared in compliance with Corps Regulation ER-1105-2-507 of 15 April 1974 for preparation of environmental statements, is included under separate cover.

Study Participants and Coordination

16. This study began in the late 1960's and early 1970's, was suspended in 1973, and resumed in 1975. During the course of this study, coordination and liaison of varying degrees of intensity and complexity was maintained with numerous federal, state and local agencies and interests. These have included the U.S. Coast Guard, U.S. Fish and Wildlife Service, Department of Housing and Urban Development, Massachusetts Executive Office of Environmental Affairs, Massachusetts Division of Marine Fisheries, Massachusetts Port Authority, Massachusetts Department of Public Works, Boston Redevelopment Authority, Boston Building Department, officials of the cities and towns within the study area, the Office of the Governor of the Commonwealth of Massachusetts, United States and State Senators and Representatives, and such organizations as the Massachusetts Bay Yacht Club Association.

17. On 11 July 1967, the initial (Stage 1) Public Hearing for this project was held in Boston. Attended by about 60 persons, the intention of this meeting was to provide all interests the opportunity to express their views and desires prior to the actual start of the Corps investigation. Comments indicated that a waterfront cleanup program aimed at the elimination of all sources of floatable debris was desired. On 30 March 1971, the Corps presented a statement of the status of the Boston Debris Study to city of Boston officials, as well as state and other interests. Following resumption of the study in 1975, a number of meetings were held with various local, state and federal representatives culminating in the Formulation Stage Public Meeting in Boston on 29 September 1977. This forum featured the detailed presentation of the Division Engineer's findings concerning the tentatively selected plan, including advantages and disadvantages of the various alternatives and solicited and obtained the views and desires of the public concerning the proposed alternatives as well.

18. This most recent meeting aided the Division Engineer in the collection of the information necessary to formulate a final plan that will best meet the local interests' desires and needs without exceeding the scope of the study authorization. As a result, in a letter dated 15 December 1977, Massachusetts Governor Michael S. Dukakis reported the state's endorsement of the Corps cleanup proposal and willingness to cooperate as required.

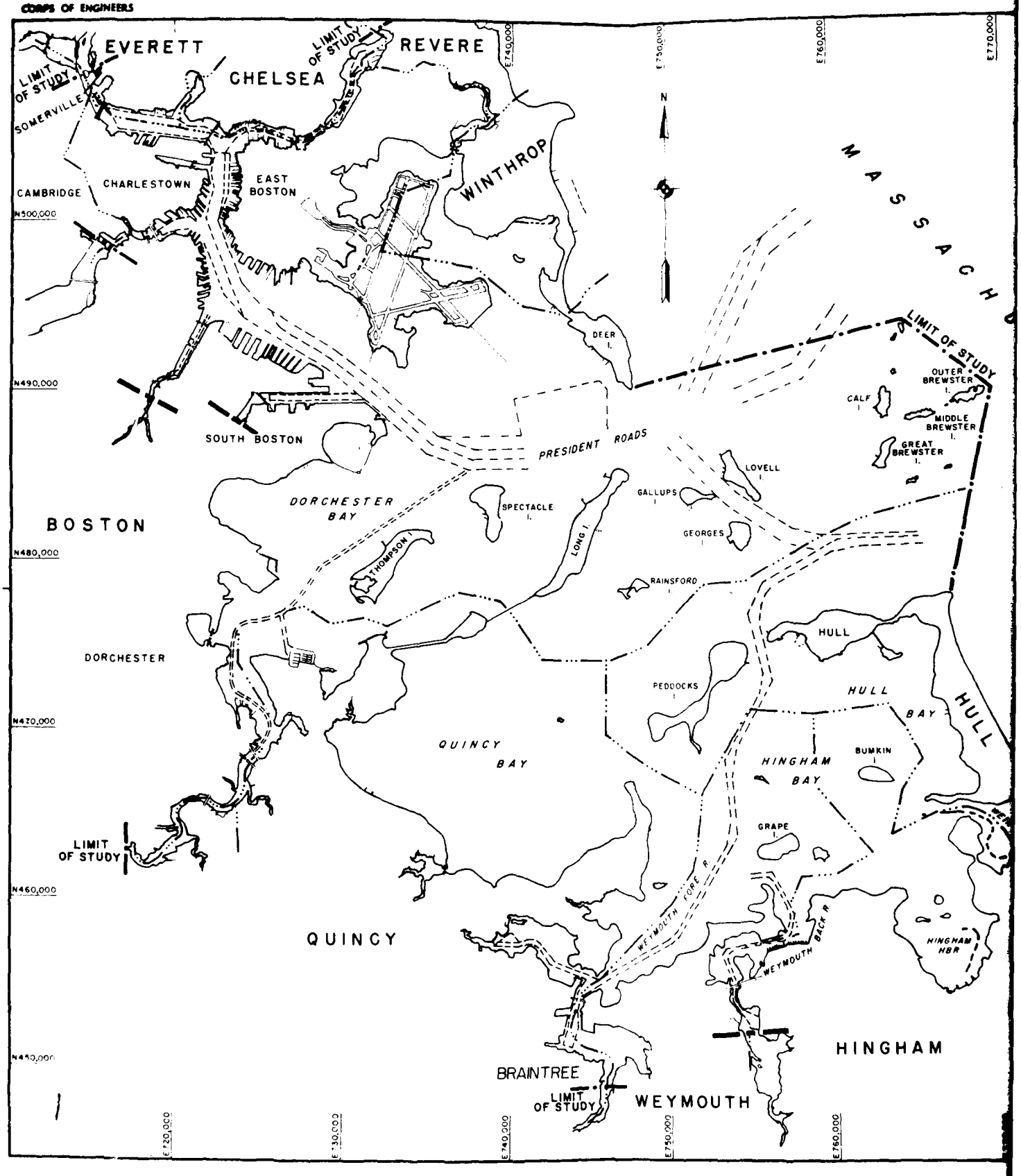
By letter of 1 November 1979, Governor Edward J. King reaffirmed the Commonwealth's support the proposal but expressed serious reservation concerning project cost sharing.

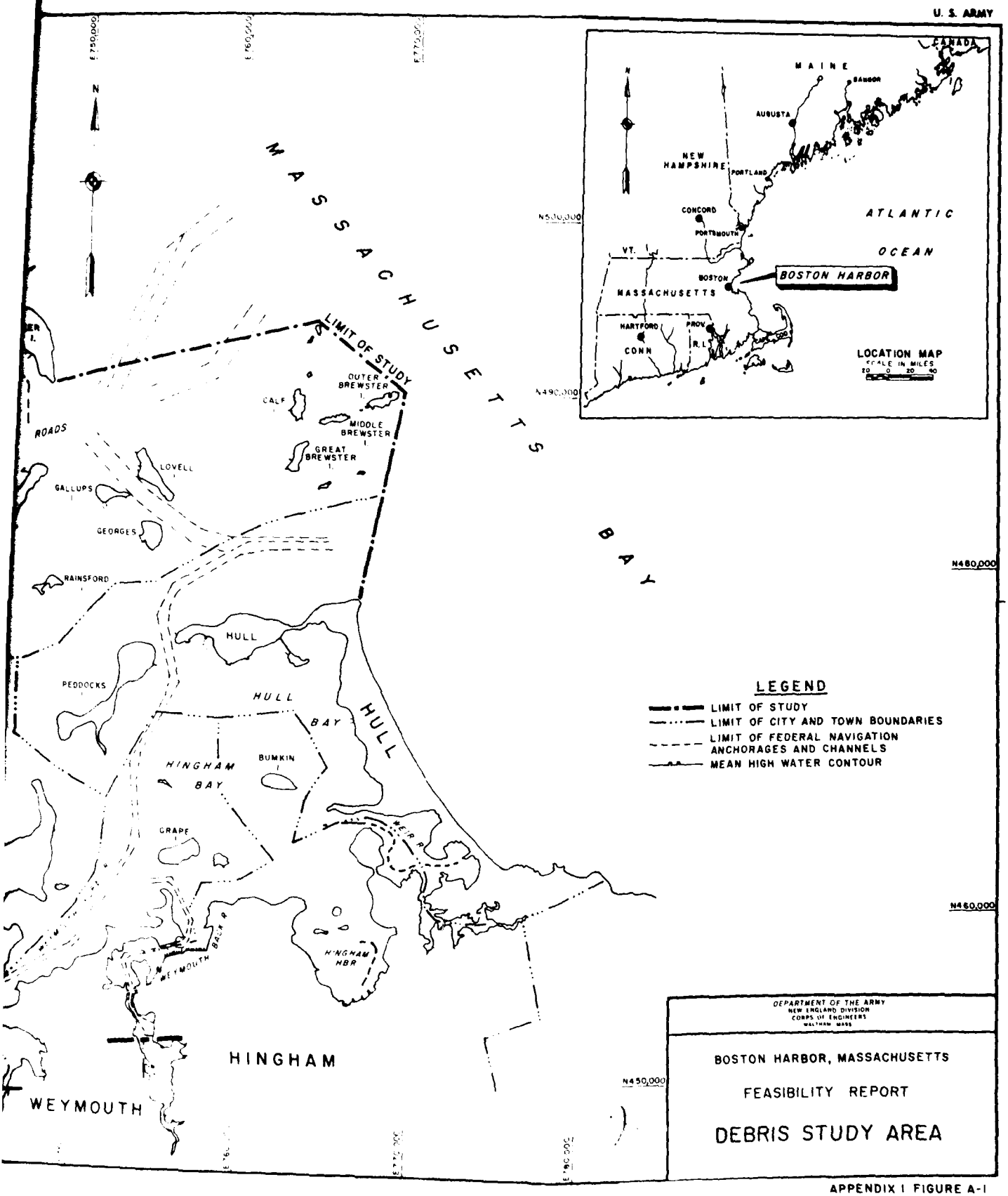
Prior Studies and Reports

19. A number of Congressionally authorized reports have been prepared by the Corps of Engineers concerning the need for debris removal in Boston Harbor. These reports were written prior to 1973 when the Office of Management and Budget, in its review of a similar study report for New York Harbor, decided that the removal and disposal of sources of floatable debris were solely the responsibility of non-federal interests. Consequently, a brief negative report on the Boston Harbor debris study was submitted.

20. Because of renewed interest by Congress concerning this problem as evidenced by the 1974 Water Resources Development Act which authorized a debris removal project in New York Harbor, this study was resumed.

CORPS OF ENGINEERS





APPENDIX I FIGURE A-1

SECTION B

RESOURCES AND ECONOMY OF STUDY AREA

RESOURCES AND ECONOMY OF STUDY AREA

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

SECTION B

RESOURCES AND ECONOMY OF STUDY AREA

1. To a large degree, the resources of a region determine the status of its economic well-being and growth potential. A general understanding of these resources and developmental trends in the area is helpful in identifying regional problems and needs as well as in selecting appropriate solutions. The following pages discuss the resources of the study area - the Greater Boston area - including the development and economy of Boston Harbor.

Environmental Setting and Natural Resources

Terrain and Land Use

2. Boston Harbor is one of the best natural harbors on the Eastern Seaboard as well as the location of the largest city and seaport in New England. Covering a tidewater area of approximately 47 square miles, the study area comprises the harbor, the Brewster Islands at the harbor mouth, estuarine portions of rivers and other waters connected to the harbor as shown on Figure B-1.

3. The harbor is part of the Boston Basin, a lowland area surrounded by a ridge of bedrock which was created millions of years ago. The recession of glacial ice at the end of the Ice Age left a number of drumlins, smooth rounded hills, around the harbor. Most of the harbor islands and the sites of some famous landmarks, such as Bunker Hill are also drumlins. Other islands are outcrops of bedrock.

4. The shoreline of the harbor is very irregular and reflects a variety of geological forces as well as man-made alterations. A major portion of the harbor, particularly areas surrounding the city of Boston, has been filled. Continuous erosion by the sea and wind has resulted in a considerable size reduction in several of the islands, culminating in the complete disappearance of some.

5. The harbor is surrounded by twelve communities. Proceeding clockwise from the South, these are: the towns of Hull, Hingham, Weymouth, and Braintree; the cities of Quincy, Boston, Cambridge, Somerville, Everett, Chelsea and Revere; and the town of Winthrop.

6. Boston has an inner and outer harbor. The inner harbor, which lies north and west of a line drawn between Logan Airport and Castle Island, includes the mouths of the Charles, Mystic and Chelsea Rivers. It is the major port and urban center of the metropolitan area, and is the source of about seventy five percent of the floatable debris in the study area. The outer harbor is divided into the three Bays of Dorchester, Quincy and Hingham, which are separated by various island groupings. There are approximately 180 miles of shoreline and an estimated 30 islands totalling about 1200 acres.

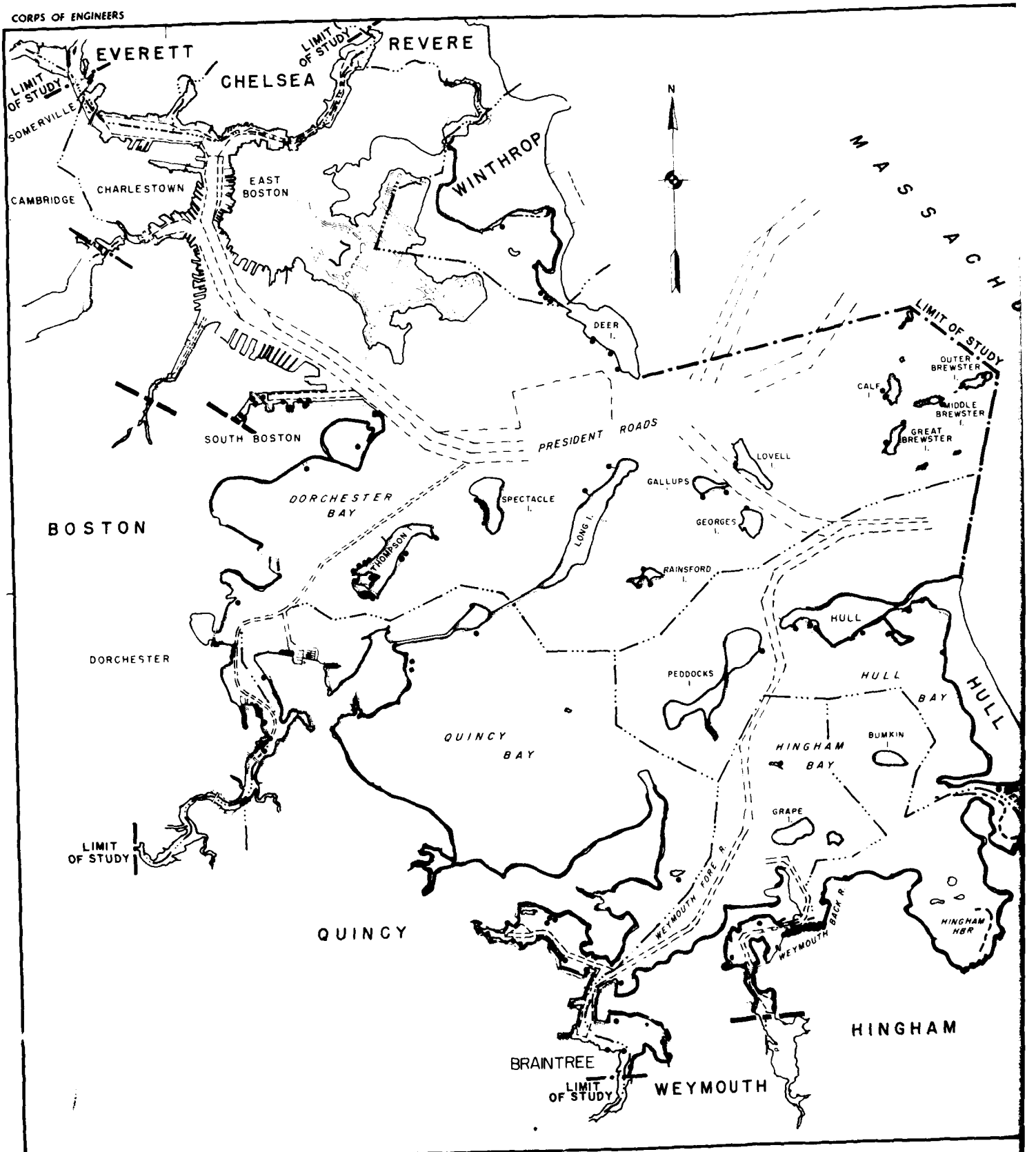
7. The peninsulas of Boston, East Boston, South Boston, and Charlestown all cluster around the inner harbor and were originally separated from the mainland by tidal marshes, which have since been filled. Originally Castle Island, Deer Island and Nut Island were separate islands, but they are now joined to the mainland by extensive fill operations. Noodle, Bird, Governor, Apple and Hog Islands were levelled to be included in Logan Airport, which alone reduced the harbor area by over three square miles.

8. Existing land uses around the harbor are shown on Figure B-1. The inner harbor shoreline is dominated by port and industrial facilities, many of which are derelict and abandoned. Port facilities have been consolidated into a few modernized piers, mainly handling containerized cargoes and bulk commodities. The major U.S. Navy Yards at Charlestown and South Boston and the Army Base on Reserved Channel have been deactivated. The Army Base has been converted into a Massport facility. The fish pier is still in operation, but it handles more fish brought by trucks from other ports than loaded directly from fishing boats.

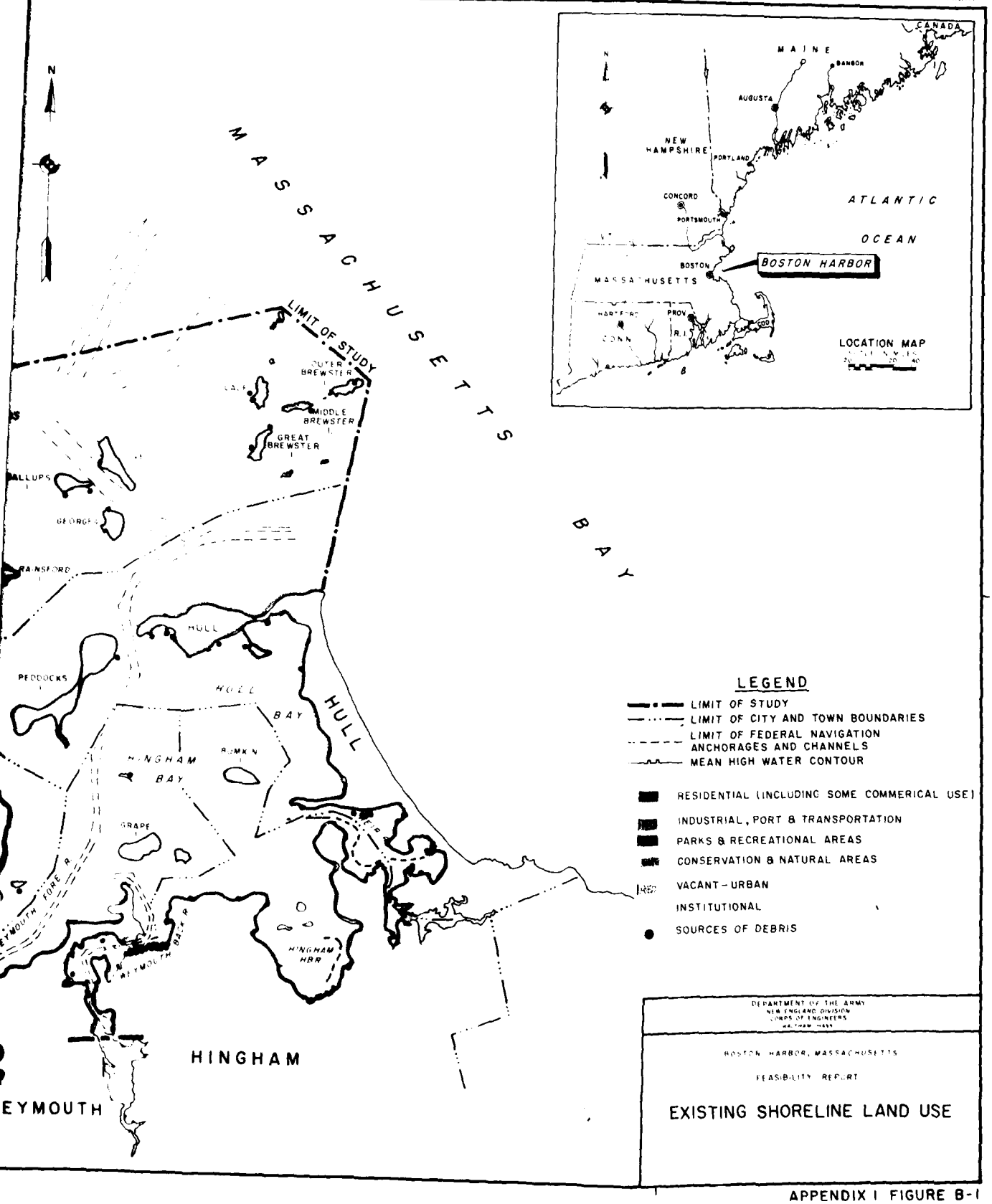
9. The North End Waterfront in the center of Boston has been renovated and many of the old stone warehouses have been converted into attractive apartments, offices, restaurants and shops. Harbor Towers, a highrise apartment block, and the New England Aquarium have been built on the waterfront. A park has been placed between Long and Commercial Wharves giving central Boston access to the waterfront.

10. One new waterfront apartment complex has been built in East Boston at the confluence of the Chelsea River and Inner Harbor. The U.S.S. Constitution is moored at Charlestown. The Chelsea Naval Hospital overlooks the Mystic River just west of the Mystic River Bridge. Elsewhere, the Mystic and Chelsea Rivers are almost completely fronted by active or abandoned industrial facilities.

11. In the outer harbor there is an active commercial port and industrial area on Weymouth Fore River and Town River Bay, including a major shipyard. There is a small industrial area on the south side of Weymouth Back River near the site of the old naval ammunition depot.


CORPS OF ENGINEERS
EVERETT
LIMIT OF STUDY
CHELSEA
LIMIT OF STUDY
REVERE
SOMERVILLE
CAMBRIDGE
CHARLESTOWN
EAST BOSTON
WINTHROP
N
MASSACHU
DEER I.
LIMIT OF STUDY
OUTER BREWSTER I.
CALF I.
MIDDLE BREWSTER I.
GREAT BREWSTER I.
SOUTH BOSTON
PRESIDENT ROADS
LOVELL I.
GALLUPS I.
DORCHESTER BAY
SPECTACLE I.
GEORGES I.
BOSTON
LONG I.
THOMPSON I.
RAINSFORD I.
HULL
DORCHESTER
PEDDOCKS I.
HULL BAY
HULL
QUINCY BAY
HINGHAM BAY
BUMKIN I.
GRAPE I.
LIMIT OF STUDY
WEYMOUTH FORE R.
WEYMOUTH BACK R.
HINGHAM HBR
QUINCY
HINGHAM
BRAINTREE
LIMIT OF STUDY
WEYMOUTH

U. S ARMY



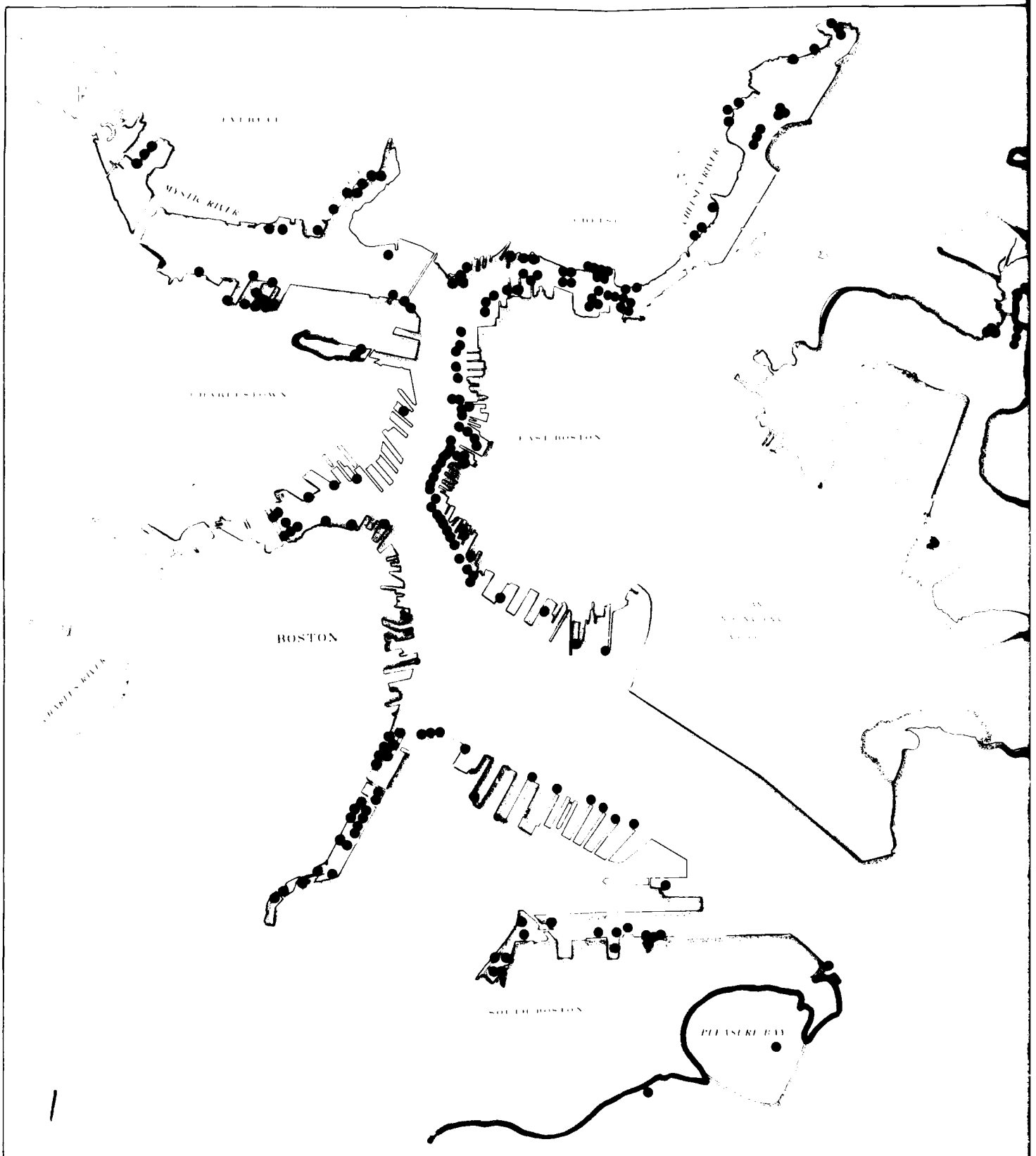
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS

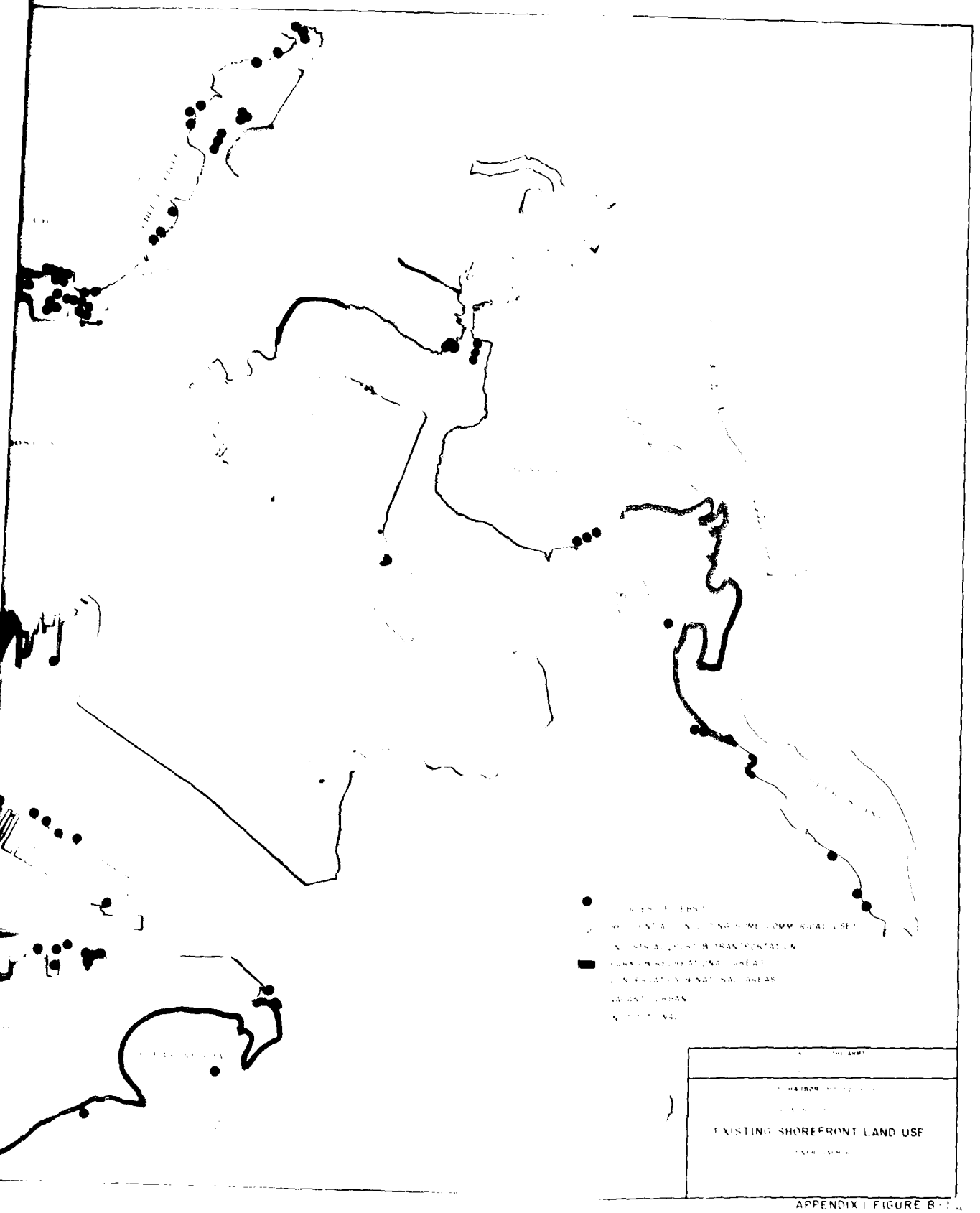
BOSTON HARBOR, MASSACHUSETTS

FEASIBILITY REPORT

EXISTING SHORELINE LAND USE

APPENDIX I FIGURE B-1


CHARLESTOWN
EAST BOSTON
BOSTON
SOUTH BOSTON
PLEASURE BAY



APPENDIX I FIGURE B-1

12. The Suffolk County Prison and a sewage treatment plant are located on Deer Island. Another sewage treatment plant is located on Nut Island. Spectacle Island, for many years a city of Boston dump, continues to smoulder from unquenchable underground refuse fires. Several islands show the remains of abandoned military sites.

Climate and Air Quality

13. Boston Harbor enjoys a moderate climate, typical of its northern temperate ocean location. Humidity and precipitation levels remain generally constant throughout the year. The average monthly rainfall is between three and four inches. There are 100 clear days, 106 days of partly cloudy weather, and 159 days of cloudy weather with no distinct seasonal patterns. Fog occurs on the average of two days per month. Average temperatures vary from about 25°F in January to 78°F in July.

14. Prevailing winds in the harbor are generally from the northwest in winter and southwest in summer. Mean wind speeds vary from about 11.2 m.p.h. in mid-summer to 14.5 m.p.h. in mid-winter.

15. Boston Harbor lies within the Metropolitan Boston Air Pollution Control District, and is subject to the Commonwealth of Massachusetts' regulations for the control of air pollution adopted under the provisions of Section 142D, Chapter III, General Laws as inserted by Chapter 836 of the Acts of 1969.

16. Air pollution control legislation in Massachusetts was first enacted in 1869. However, effective legislation was not implemented until 1960, after a furor created by an exceptional soot-fall on 13 May 1960 in South Boston.

17. A concerted campaign began in 1961 to stop all open burning of rubbish, trash, demolition materials, scrap automobiles and scrap wire in Metropolitan Boston. Today, open burning of scrap autos and wire, previously a common practice, has been stopped. In the early 1960s large quantities of combustible demolition debris, principally from urban renewal efforts, was routinely reduced by open burning. This was halted in 1964. At present, such debris is largely disposed of by sanitary landfill or by burning on burn barges in Massachusetts Bay outside Boston Harbor. In 1965, the Department of Public Works prohibited brush burning in highway land clearance contracts throughout the metropolitan district. The open burning of rubbish and brush at municipal and private dumps has also been stopped.

18. The air pollutant of greatest concern in the Boston area is total suspended particulates. In 1976 primary standards for particulates, the standards requisite to protect public health, were exceeded once. Secondary standards for particulates, standards requisite to protect the public welfare from any known or anticipated effects associated with the presence of particulates, were exceeded eleven times. A major concern is that limitations to control particulates will limit industrial expansion in the area.

19. Ambient noise levels obviously vary greatly around the harbor. The amount of disturbance caused by a source of noise would depend on location and type of neighboring activity. All the communities around the harbor, except Cambridge and Somerville, have adopted ordinances to control noise levels.

Ecology

20. Boston Harbor, an urban estuarine environment, is extensively utilized for fishing, recreation, shipping, and commercial and industrial activities. A uniform high level of water pollution existing in Inner Harbor restricts the area's use to recreational boating, fishing and industrial activities. The Outer Harbor is suitable for swimming, fishing, boating and shellfishing with depuration. The major sources of water pollution in the harbor include combined sewer overflows, debris and refuse, wastewater treatment facilities, tributary streams, ships and pleasure boats' discharge,and stormwater runoff.

21. Dorchester Bay and Inner Harbor are dominated by downtown Boston with its dense development. Commercial development along the Dorchester Bay and Inner Harbor has basically destroyed the natural environment once present.

22. Many of the islands along the shoreline have been used for ecologically undesirable purposes, such as for prisons, sewage treatment facilities, dumps, and military sites.

23. Despite such commercial and industrial development along harbor waters, a surprising proportion of the harbor remains undeveloped, but these areas are rapidly diminishing.

24. The landscape and vegetation of the harbor area, including the islands, have been extensively altered by man. The predominant characteristic of the upland vegetation in natural areas is thick impenetrable brush, while some areas are composed of a variety of trees and shrubs.

25. The water, marshes and terrestrial areas within the harbor provide habitats for a wide variety of birds, mammals, finfish, shellfish and other animals. Birds are the most abundant form of wildlife, especially on the islands. Existing types include common songbirds, shorebirds and migratory waterfowl as well as some uncommon species. Significant populations of small mammals, such as rabbits, squirrels, raccoons and skunks, are associated with the mainland, while rats predominate on the islands. The islands also support a great abundance of different types of insects because of the abundant food and cover supply.

26. Marine life within the harbor forms a significant food chain and is an important recreational and commercial resource. Many of the finfish species existing in the Boston Harbor are actively fished; in fact some, notably flounder and cod, support a valuable commercial industry. Soft-shell clams, blue mussels, crabs and lobsters are also found in the harbor. Most of the soft-shell clam sites, though, are closed to the taking of shellfish because of pollution (see Figure B-2). In the remaining areas, shellfish can be harvested only by licensed master diggers or their employees and must undergo depuration at the Shellfish Purification Plant. No shellfish areas are open to unrestricted harvesting. Lobsters are abundant throughout the harbor and are caught in traps or by diving for recreation as well as sale. Other marine animals such as bloodworms and sea worms, as well as numerous small fish, may be found along the shorelines of many islands.

27. A comprehensive water quality study was carried out in Boston Harbor by the New England Aquarium in 1970-1972. 1/ The results of this study are summarized in Table B-1. Turbidity, color and suspended solids were found not to vary greatly between seasons, but are maximum near sewage outfalls. Temperature and salinity measurements were characteristic of a well mixed harbor where freshwater inflow contributes only to local stratification. The nitrogen and phosphorus data suffered from inconsistencies in analytical reporting, neither the site of sampling nor the parameters measured were constant throughout the study.

28. The biological parameters which were measured showed some general trends. The phytoplankton populations in the Mystic, Chelsea and Malden Rivers were substantially greater than those measured in the outer harbor. In addition, the number of phytoplankton in the harbor decreased by one half from 1967 to 1968. Benthic sampling showed a very significant reduction in the population size of pollution tolerant species, especially the polychaete worms. Bacterial counts were high in the vicinity of the sewage outlets at Deer Island, Moon Island and Nut Island, but had substantially decreased as the result of a program of chlorination which was started in 1969.

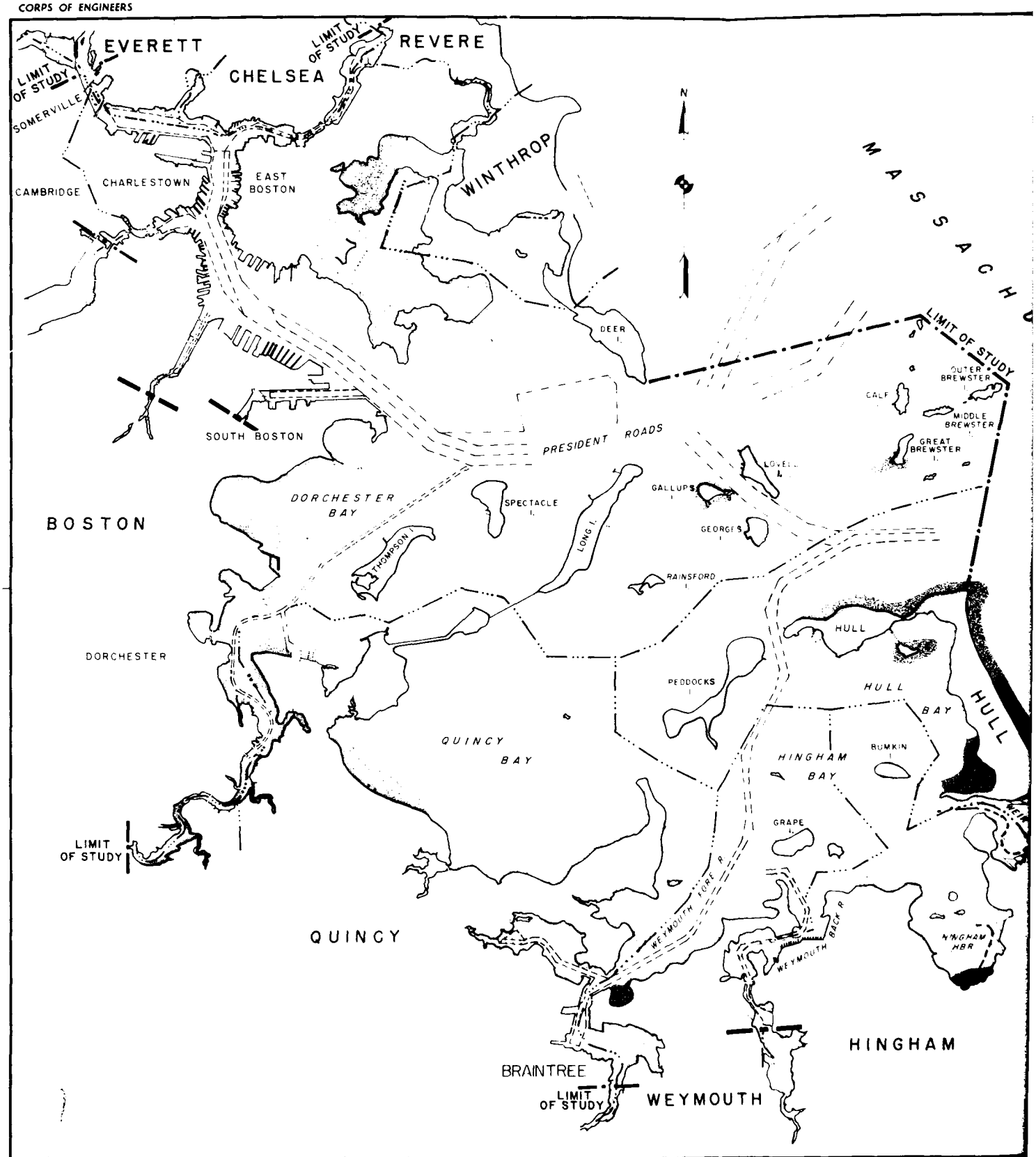
1/ New England Aquarium, Research Department, "Water Quality Measurements of Poston Harbor", Vol. I, Sept. 1973.

TABLE B-1

WATER QUALITY IN BOSTON HARBOR 1970-1972

	Minimum-Maximum Values		
Physical Parameters	Inner Harbor	Outer Harbor	Outside Harbor
TO C.	0-21	0-22	0-2-.5
Salinity, ppt	4-32	21-34	28-34
Chemical			
D.O., ppm	2.41-11.49	6.02-14.0	6.48-12.65
Nitrogen mg/1			
Ammonia - N	0.01-1.10	0.01-1.02	0.01-0.40
Nitrate - N	.002-1.24	.001-.570	.002-.940
Phosphorus			
Total	0.05-1.02	.024-1.33	.010-.133
Ortho	.007-.924	.010-1.17	.018-.-82
Biological			
Bacterial cts. (coliform)	0-96,000	0-10,000	0-4,200

CORPS OF ENGINEERS



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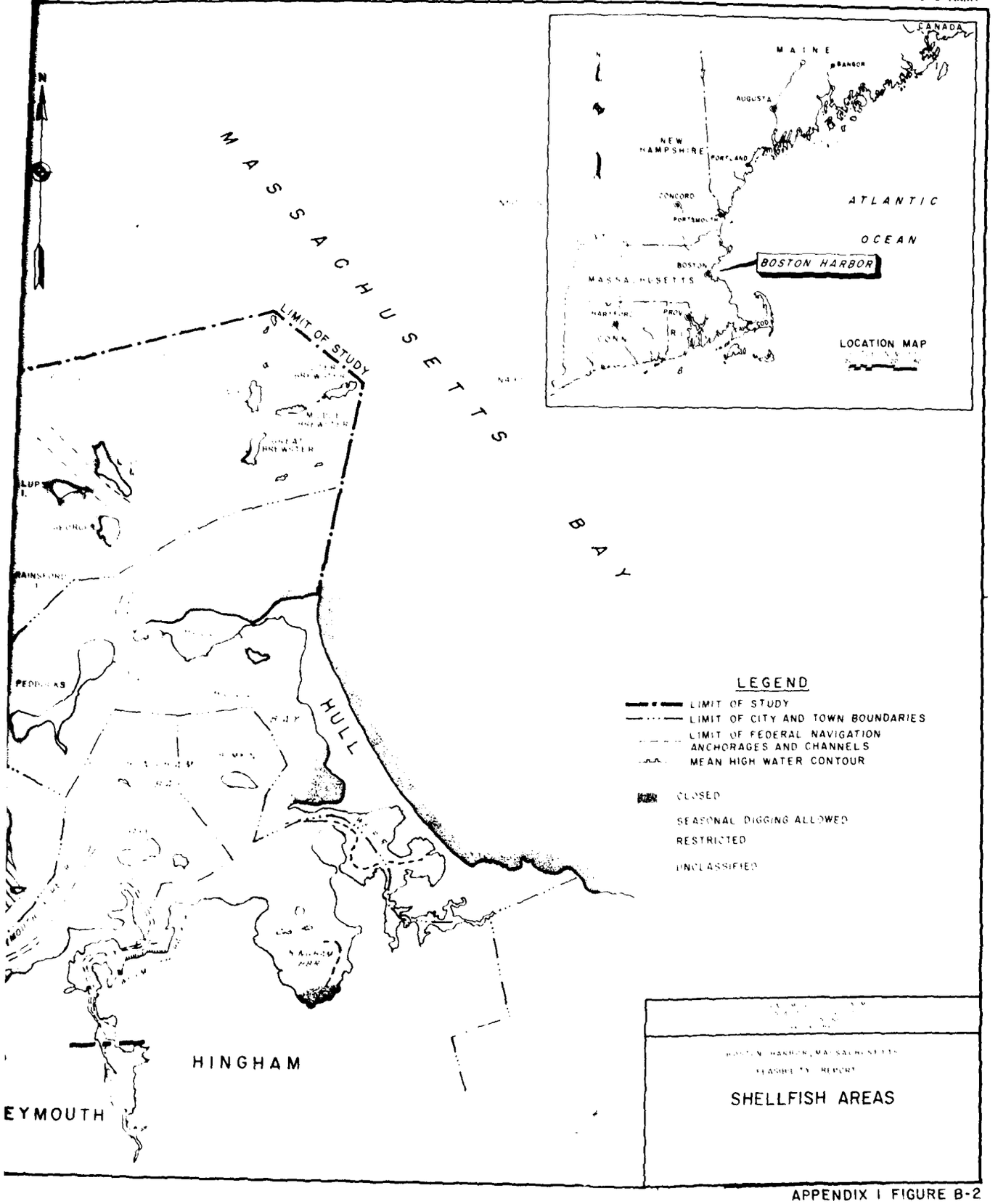


BOSTON HARBOR, MASSACHUSETTS
FEASIBILITY REPORT

SHELLFISH AREAS

APPENDIX I FIGURE B-2

29. Salinity measurements indicate that the entire harbor is a polyhaline zone merging into a stenohaline zone near the harbor entrance. Areas affected by freshwater flow are small since the rates of river flow into the harbor are small. The highest nitrogen and phosphorus measurements were taken in the River Complex Region because of the high untreated sewage loads being carried by these rivers. Occasionally, nitrogen and phosphorus measurements were high in the outer harbor and outside the harbor entrance. This was attributed to discharges from the Deer Island Wastewater Treatment Plant. Coliform counts varied throughout the harbor. Dissolved oxygen levels were lowest at the mouths of the rivers. This is probably due to their high chemical and biochemical oxygen demand.

30. Boston Harbor is one of the few areas along the Massachusetts coastline which furnishes good sport fishing year round. The species fished include winter flounder, Atlantic mackerel, striped bass, rainbow smelt, Atlantic cod, pollock, Atlantic tomcod and red hake. Sport fishermen can board party and charter boats and usually catch haddock, cod, flounder, mackerel, pollock, cusk and eel.

31. There are approximately 1200 acres of salt marsh remaining within the harbor. These areas are ecologically important because they contain suitable habitat for wildlife; function as nurseries for marine organisms, especially finfish; and are significant sources of vegetative biomass to the food chain of the harbor estuary.

Historical-Archeological Features

32. A cultural resource reconnaissance of the study area located 122 structures and 2 shorefront dumps which may constitute significant resources due to their historical associations and/or potential archaeological value. Ten of these structures and one dump are located within or directly adjacent to properties on the National Register of Historic Places. A more complete description of these resources may be found in Appendix 5 of the Feasibility Report. Derelict vessels were not examined in the reconnaissance, but will be considered in a separate study if the project proceeds to design stage.

Human Resources

Population Characteristics

33. As described by Table B-2, dense urban concentrations of population surround the inner harbor with the cities of Boston, Cambridge, Somerville, Everett and Chelsea. As is to be expected, population densities vary inversely with distance from the metropolitan core, with the exception of the towns of Winthrop and Hull at the extremities of the bay. These towns, with very limited areas and considerable waterfront, have been subjected to a high level of development.

34. While the populations of all the communities increased between 1900 and 1940, between 1940 and 1975 the populations of the core cities decreased, while the suburban communities increased. The greater the distance from the core, the greater the rate of increase. This is typical of the movement of population from cities, which has occurred since World War II. However, it is significant that the cities of Boston and Cambridge, with their cultural roots, attractive residential areas, and, in the case of Boston, active urban renewal programs, have been able to slow or reverse the exodus between 1970 and 1975, while the exodus from the largely industrial cities of Somerville, Everett and Chelsea has accelerated and spread to adjoining Revere. In fact, the population of Chelsea was lower in 1975 than in 1900. By 1970 population growth rates in suburban communities had declined, with the exception of Quincy.

35. One of the features of the population movement from the cities to the suburbs has been that the upper and medium income brackets have moved out, while the low income brackets have remained and increased. As a result, the per capita and, at times the total tax base has fallen, while welfare rolls and schools have filled with resulting fiscal crises for cities. This trend in Metropolitan Boston is demonstrated by Table B-2 showing mean incomes in the core cities to be lower than those in the suburban areas.

36. Despite considerable decline, waterfront areas in the inner harbor have not become ghettos inhabited by minority groups. A major reason for this is that waterfront communities have maintained a considerable amount of social cohesion during a period of population loss. Efforts to settle minority groups in new housing projects along the waterfront, at Maverick Square in East Boston, and Columbia Point in Dorchester, have not been very successful. The North End of Boston is a strongly ethnic community. Its population is primarily Italian, both in ethnic origins and social behavior. There is also a large Italian community in East Boston whereas South Boston has a strong Irish community.

Table B-2 POPULATION CHARACTERISTICS OF BOSTON HARBOR COMMUNITIES

Community	Population								
	1900	1910	1920	1930	1940	1950	1960	1970	1975
Hull	1,703	2,103	1,771	2,047	2,167	3,379	7,055	9,961	10,572
Hingham	5,059	4,965	5,604	6,657	8,003	10,665	15,378	18,845	19,544
Weymouth	11,324	12,895	15,057	20,882	23,868	32,690	48,177	54,610	56,854
Braintree	5,981	8,066	10,580	15,712	16,378	23,161	31,069	35,050	36,822
Quincy	23,899	32,642	47,876	71,983	75,810	83,835	87,409	87,966	91,487
Boston	574,136	686,092	748,060	781,188	770,816	801,444	697,197	641,071	637,986
Cambridge	91,886	104,839	109,694	113,643	110,879	120,740	107,716	100,361	102,095
Somerville	61,643	77,236	93,091	103,908	102,177	102,351	94,697	88,779	80,596
Everett	24,336	33,484	40,120	48,424	46,784	45,982	43,544	42,485	39,713
Chelsea	34,072	32,452	43,184	45,816	41,259	38,912	33,749	30,625	25,066
Revere	10,395	18,219	28,823	35,680	34,405	36,763	40,080	43,159	41,292
Winthrop	6,058	10,132	15,455	16,852	16,768	19,496	20,303	20,335	20,359

Community	Rate of Growth (%)			Population Density	Mean Income
	1900/1940	1940/1975	1970/1975	1975 persons/sq. mi.	1969 $
SMSA					10,400
Hull	.60	4.63	1.20	4,179	10,669
Hingham	1.15	2.58	.73	865	14,807
Weymouth	1.88	2.54	.81	3,208	12,712
Braintree	2.55	2.34	.99	2,555	12,758
Quincy	2.93	.54	.79	5,498	10,097
Boston	.74	-.54	-.10	14,052	7,330
Cambridge	.47	-.24	.34	14,299	7,292
Somerville	1.27	-.68	-1.95	19,562	8,315
Everett	1.65	-.50	-1.36	10,590	9,366
Chelsea	.47	-1.43	-4.09	11,551	7,923
Revere	3.04	.52	-.89	6,534	9,621
Winthrop	2.58	.56	.02	10,950	12,496

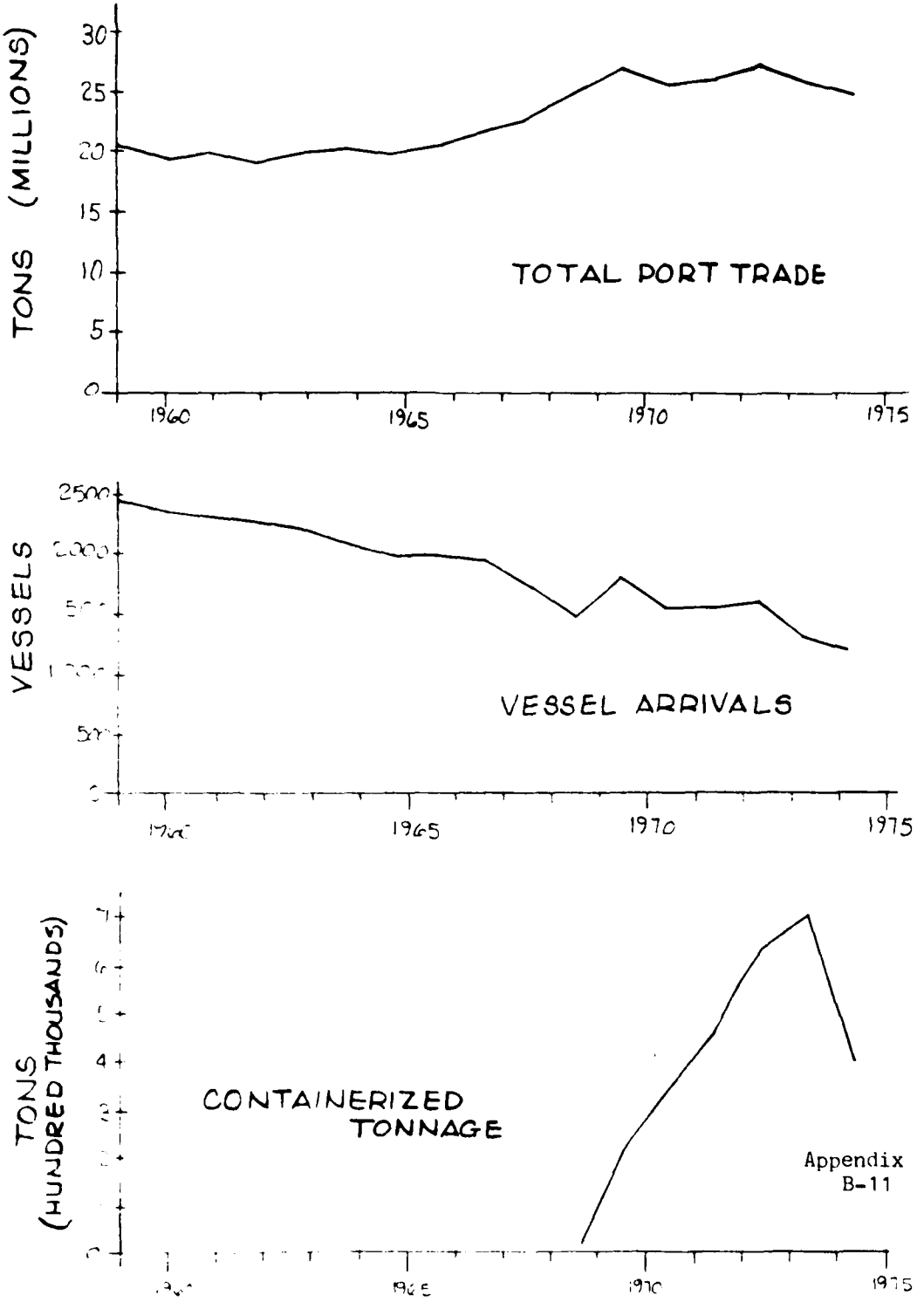
Changing Setting of Harbor

37. During the early stages of the Industrial Revolution, water was both a prime source of power for industry and the main means of transport. With the advent of the steam engine and railroads, dependence on water was lessened, but transport by sea still remained cheaper than by land. An ocean port such as Boston is the interface between land and sea, and also the point of arrival of merchandise from foreign lands. The port's waterfront was not only the point for transfer from ocean to inland transport, but the point at which goods had to be inspected and customs duties assessed. It was the logical point to store and distribute imports as well as to locate industries dependent on seaborne materials. There were also a large number of sea related activities, such as ship building, ship repairs, and provisioning. Prior to the development of air transport, ports handled all transoceanic passenger traffic. This resulted in a high demand for waterfront land and its intense development for port, commercial and industrial activities.

38. The picture has now largely changed, due to modern means of transporting and handling goods. The introduction of containers as an important means of transporting general merchandise, coupled with the inland transport under customs bond (i.e. sealed), has made it convenient to locate the point of customs clearance and distribution inland. Ship building has declined dramatically in the United States and is concentrated in a few highly mechanized shipyards, such as the General Dynamics Yard in Quincy. Ship repairing has gravitated to countries with low labor costs and many repairs are carried out at sea while the ship is in operation.

39. The most dramatic shift in waterfront usage has come about from modern methods of transport, such as continuous roll on/roll off ships and LASH barges. The recent rapid increase in container traffic is shown on Figure B-3. These methods have drastically shortened the time to load and unload ships, and have involved heavy capital investments in ships and dock equipment which make it imperative that ships be turned around in minimum time to be profitable. A large container ship can be turned around in eight hours, whereas an equivalent breakbulk (non-containerized general cargo) ship would require 36 hours or 4 to 5 days working eight hours a day. Any vessel not vacating its berth on completion of its operations is subject to the heavy charge of $75.00 per 15 minutes at the Moran Container Terminal. The size of the ships has also increased. This can be seen from Figure B-3, where the number of vessel arrivals in the harbor has steadily decreased, while tonnage handled has increased. This has led to a huge decrease in the number of berths and piers needed to handle port traffic. Further modern handling methods require entirely different layouts, entailing major reconstruction. Old wharves are abandoned and replaced by new ones at other locations.

FIGURE B-3 PORT OF BOSTON - PORT TRADE, VESSEL ARRIVALS, AND CONTAINERIZED TONNAGE
(SOURCE - MASSPORT)



40. The overall result has been the abandonment of waterfront sites or their conversion to other industrial or commercial uses not requiring waterfront access. Piers have been allowed to deteriorate, vessels have been allowed to sink without removal, and debris has accumulated. Furthermore, with the abandonment of sites and streamlining of handling methods, waterfront employment has decreased dramatically. Residential areas built to house waterfront workers have degenerated.

41. In Boston the effects have been greatly compounded by the closing of three major military installations which supported a sizeable labor force and many ancilliary industries.

42. The result is to present cities surrounding the inner harbor with an aspect of large scale desolation around their greatest attraction and reason for existence. It also presents them with a great opportunity for redevelopment. Attractive waterfront sites have a great potential for residential and commercial use. Increased values of residential property with an attractive waterfront is well demonstrated. Houses near Brophy Park in the Jeffries Point District of East Boston, with a view over the harbor to Central Boston, fetch about $8,000 more than houses without a view, according to an East Boston realtor. A study 1/ was done of 1975 sales of condominiums on Beacon Street and Marlborough Street between Arlington Street and Massachusetts Avenue. The average price of 19 condominiums on the north side of Beacon Street, which has a view across the Charles River to M.I.T., was $44,500. The average price of 26 condominiums on the south side of Beacon Street, and on Marlborough Street, which do not have a view, was $38,290. Apartment rents in the Mercantile Building facing the harbor across a park are about $25 per month higher than those facing the rear of the building.

43. In Boston, the North End waterfront between Lewis Wharf and the entrance to Fort Point Channel has been redeveloped. Warehouses on Lewis, Commercial and Long Wharves have been converted into attractive offices, shops, restaurants and condominiums by private developers with city assistance. The New England Aquarium and a high rise block of apartments were built on the waterfront. The city of Boston has invested over $6,000,000 in improving streets, sidewalks, sewers and lighting as well as a waterfront park. The success of the project can be attested by the fact that $60,000 is being asked for one bedroom apartments on Lewis Wharf in 1977, which were sold for $42,000 when the building opened in 1973.

1/ Records of sales in 1975 were obtained from the Boston Redevelopment Authority. Only condominiums in older buildings were considered, 180 and 324/344 Beacon Street, modern relatively high rise apartment blocks being excluded. Thus, while individual apartments were not inspected, the apartments in similar houses were compared.

Development and Economy

General Economic Activity

44. Boston Harbor is surrounded by the largest metropolitan area in New England with a population approaching four million. While not one of the most rapidly expanding areas in the United States, the Boston area is nevertheless maintaining a dynamic and expanding economy. The Obers Series E Projections for the area are reproduced in Table B-3.

45. The Boston area is known for its universities and large numbers of colleges which are recognized as institutions of learning of the highest international standing. These have spawned a large number of research firms, firms manufacturing advanced technical equipment, and specialized consultant firms of national and international repute. This is reflected in Table B-3 where earnings from professional services, which includes university staff and consultants, are projected as 18.2 percent of total earnings in 1980, as compared to the national average of 12.0 percent.

46. On the other hand, for the reasons explained in the previous section, waterfront industrial and commercial activity has decreased significantly in the last 30 years. Not only has the amount of required waterfront space decreased, but the number of jobs per foot of frontage has also decreased. Off-loading and loading traditional breakbulk ships is not only slow, but labor intensive. Conversely, container ships, roll on/roll off, and LASH ships can be off-loaded at a rapid rate, using small crews of longshoremen. Labor intensive industries such as ship building, ship repairing, Navy Yards and fishing have greatly diminished. Facilities handling bulk products such as oil, cement and sugar, with relatively low labor requirements, have remained.

47. Boston Harbor is not the site and is unlikely to become the site of modern industries such as steel, petroleum refinery and petrochemicals which favor locations with direct access to port facilities.

48. When it is considered that other traditional New England labor intensive industries such as textiles have also declined, it can be seen that Greater Boston's continued prosperity depends greatly on attracting firms in advanced technology who wish to tap

TABLE B-3

BOSTON SMSA

Population, Employment, Personal Income, and Earnings by Industry, Historical and Projected, Selected Years, 1950-2020

	1950	1962*	1969	1970	1971	1980	1985	1990	2000	2020
Population, mid-year	3,092,393	3,429,326	3,682,793	3,715,118	3,774,197	4,013,200	4,334,500	4,542,600	4,995,500	5,819,100
Per capita income (1967 $)	2,279	3,615	3,949	4,026	4,113	5,700	6,200	7,000	9,200	14,500
Per capita income relative (U.S. = 1.00)	1.10	1.17	1.15	1.17	1.16	1.16	1.15	1.15	1.13	1.10
Total employment	1,195,818	1,339,478		1,547,299		1,883,300	1,987,200	2,096,700	2,356,300	2,661,800
Employment/population ratio				41		46	46	46	47	46
						In Thousands of 1967 Dollars				
Total personal income	6,977,741	10,338,786	14,543,083	15,047,359	15,433,608	22,863,600	27,167,900	32,310,500	46,167,100	84,594,600
Total earnings	5,591,541	8,472,637	11,718,449	11,966,824	12,126,309	17,871,000	21,151,000	25,032,900	35,465,700	64,551,000
Agriculture, forestry and fisheries	79,392a	57,429a	56,911a	55,388a	55,591a	69,900	73,200	76,700	87,300	113,500
Agriculture						53,900	55,200	57,400	64,600	80,400
Forestry and fisheries						15,900	17,900	19,300	23,700	33,100
Mining	2,878b	3,836b	3,713a	4,044a	4,462a	6,100	6,600	7,200	8,600	11,800
Metal										
Coal						(S)	(S)	(S)	(S)	(S)
Crude petroleum and natural gas						6,100	6,600	7,200	8,600	11,800
Nonmetallic, except fuels										
Contract construction	353,547	481,242	741,885	774,622	836,884	1,138,600	1,320,000	1,529,900	2,072,700	3,460,800
Manufacturing	1,726,768	2,586,384	3,121,629	3,065,705	2,926,612	3,955,900	4,383,800	4,869,100	6,200,000	9,613,000
Food and kindred products						243,500	259,600	275,000	330,600	451,100
Textile mill products						85,300	80,200	77,300	79,400	91,400
Apparel and other fabric products						122,900	122,900	123,900	135,900	170,400
Lumber products and furniture						56,100	60,100	64,300	78,900	110,700
Paper and allied products						134,900	150,100	163,600	202,100	299,400
Printing and publishing						336,200	329,300	429,200	567,600	950,800
Chemicals and allied products						151,500	177,100	202,500	261,600	483,300
Petroleum refining						8,700	9,100	9,600	11,600	14,100
Primary metals						48,900	47,200	48,500	52,900	65,300
Fabricated metals and ordnance						415,900	439,500	567,200	768,500	1,284,200
Machinery, excluding electrical						533,900	590,900	673,200	931,100	1,247,000
Electrical machinery and supplies						776,200	893,200	918,900	1,170,600	1,813,400
Motor vehicles and equipment						68,900	72,200	85,200	102,500	158,800
Transportation equip., excl. mtr. vehs						163,100	214,400	223,900	260,200	349,700
Other manufacturing						861,500	965,700	1,023,400	1,335,600	2,133,700
Trans., comm. and public utilities	407,176	570,499	764,574	793,491	823,894	1,203,100	1,422,500	1,685,200	2,367,500	4,182,400
Railroad transportation						43,600	43,600	43,100	41,100	41,900
Trucking and warehousing						295,300	351,000	417,300	580,500	1,039,200
Other transportation and services						293,900	335,600	389,700	514,100	813,100
Communications						405,300	499,000	614,200	925,100	1,302,500
Utilities (elec., gas, sanitary)						164,900	192,400	221,000	296,600	485,800
Wholesale and retail trade	1,216,737	1,573,519	2,087,543	2,131,980	2,151,561	2,973,200	3,388,200	3,862,100	5,154,800	8,302,600
Finance, insurance and real estate	336,175	588,694	845,944	849,973	888,389	1,316,100	1,584,200	1,896,900	2,644,300	4,925,100
Services	749,595	1,415,674	2,423,183	2,524,148	2,599,391	4,574,300	5,764,400	7,245,200	11,275,200	23,171,500
Lodging places and personal services						203,100	222,200	242,600	293,800	417,500
Business and repair services						963,600	1,239,400	1,539,100	2,429,200	5,168,600
Amusement and recreation services						83,000	97,200	112,500	150,700	244,700
Private households						68,300	70,200	72,100	79,200	98,300
Professional services						3,252,200	4,135,200	5,299,000	8,323,200	17,392,400
Government	709,054	1,197,743	1,664,227	1,759,096	1,870,926	2,631,300	3,187,600	3,849,300	5,604,900	10,630,300
Federal government	296,017	357,968	449,649	473,180	478,549	617,600	751,200	885,100	1,213,800	2,253,600
State and local government	408,999	677,515	1,034,769	1,139,069	1,230,228	1,908,400	2,221,300	2,728,500	4,040,500	7,875,700
Armed forces	94,049	152,260	180,407	145,839	161,718	105,100	208,900	235,700	351,500	491,000

*Employment is for 1964.
a—represents 80.0 to 99.9 percent of the true value
b—represents 60.0 to 79.9 percent of the true value
c—represents 40.0 to 59.9 percent of the true value
d—represents 20.0 to 39.9 percent of the true value
e—represents zero to 19.9 percent of the true value

Source: 1972-E OBERS Projections

the pool of highly skilled professionals available in the area. Professional manpower is highly mobile and will prefer to locate in an area where they can find social, cultural and recreational opportunities to suit their taste.

49. Boston, with its many local and regional historical associations, also has a major potential as a tourist center, which can be fully realized on completion of the urban renewal presently underway.

Plans for New Waterside Commercial and Industrial Activities

50. The major plan is for the redevelopment of the South Boston Navy Yard site. Massport has presented a proposal for the complete redevelopment of the site as a container terminal.1/ This will also involve the conversion of the existing Moran Container Terminal on the Mystic River to a bulk facility. The city of Boston Economic Development and Industrial Commission (EDIC), however, argues that a major portion of the site be redeveloped for industrial purposes, providing much needed employment in Boston. The Massport plan does not require the removal of the dilapidated finger-pier between the dry dock and the south jetty, but indicates the possibility of removing these piers and filling this forty-acre area at an unspecified later date, if the need arises. On the other hand, the EDIC plan foresees the immediate removal of these piers. The filling of this area will interfere with tidal flows into the inner harbor and is likely to be the subject of controversy.

51. There is also a plan for the modernization of the Boston Fish Pier just to the north of the Navy Base, which has not been approved at this date.

52. The 1965/1975 city of Boston General Plan 2/ identifies the upper shoreline of the Chelsea River in East Boston as an area for redevelopment for industrial use. Part of this area has also been identified as a conservation area under the Boston Urban Wilds Program.

Plans for Waterside Renewal and Residential Redevelopment

53. The major plan for waterside redevelopment focuses on the Charlestown Navy Yard. The Yard was decommissioned in 1974 after 174 years of military service. The plan calls for the redevelopment for

1/ A Proposal for the Development of Container Terminal at the South Boston Naval Annex and Army Base. Second draft, January 1977, Massport.

2/ The 1965/1975 General Plan for the City of Boston and the Regional Core. Boston Redevelopment Authority, 1964.

mixed uses, including a historic monument area, public park, and also a mixed use area including industry, hotel conference center, offices, housing and a marina.

54. The 1965/1975 General Plan for the city of Boston indicates the intention of redeveloping much of the East Boston waterfront for residential purposes. To date, Shore Plaza East, a 380 unit low and moderate income apartment complex and a new school have been completed on Border Street. There are plans for a mixed housing - commercial - open space development on the waterfront below Maverick Square.

Plans for Waterside Recreation and Conservation Areas

55. The Metropolitan Area Planning Council (MAPC) and the city of Boston are both very active in preparing plans for recreational development and conservation of land along the waterfront. The major emphasis of the waterfront plans of these agencies is towards those areas which provide for public enjoyment of the harbor and the preservation of its ecological resources.

56. In 1976 the MAPC published the Boston Harbor Islands Comprehensive Plan.1/ Under this plan it is proposed to protect all the harbor islands from undesirable uses and to either develop their potential as historical sites and recreation areas, or to leave them undeveloped as conservation areas. The plan also envisages turning much of the outer harbor waterfront into conservation areas. The main features of the plan are shown on Figure B-4.

1/ Boston Harbor Islands Comprehensive Plan, prepared for Massachusetts Department of Natural Resources by the Metropolitan Area Planning Council, October 1976.

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BOSTON HARBOR, MASSACHUSETTS MAIN REPORT FOR DEBRIS REMOVAL. VO--ETC(U)
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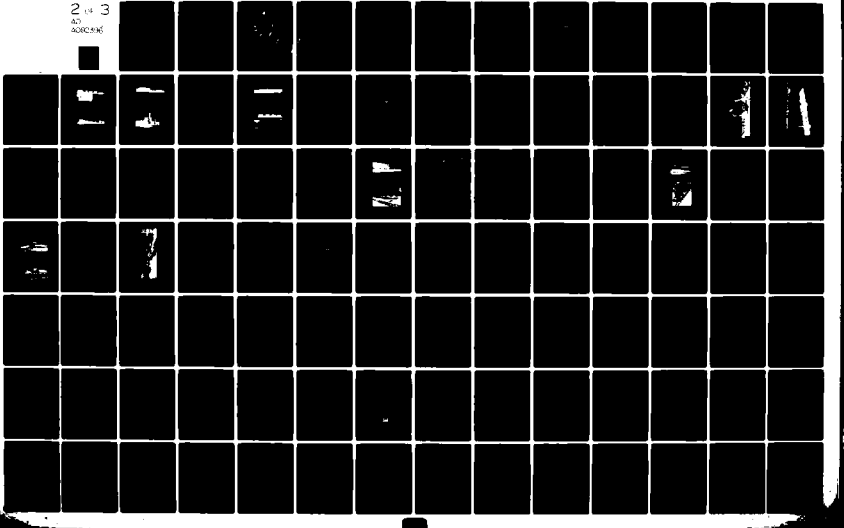

57. The plan envisages the development of harbor islands to provide the following annual recreational opportunities:

Group Camping	34,000	Recreation Person/Days
Family Camping	6,000	" " "
Primitive Camping	1,200	" " "
Fishing	54,000	" " "
Play	220,000	" " "
Historic Fort Visitations	305,000	" " "
Swimming	335,300	" " "
Picnicking	203,600	" " "
Boating	111,000	" " "
Hiking, Nature Walks, etc.	222,850	" " "
Conference and Recreation Center	130,000	Recreation Days
Model Farm Visitation	70,000	" "
Fish Hatchery Visitation	10,000	" "

· MAPC published the 1976 Regional Open Space Plan in July 1976. In addition to the Harbor Islands Plan, it proposed that the following recreational and conservation areas be developed or improved along the harbor front.

· Chelsea Naval Hospital. A 20 acre waterfront park is recommended for the southwestern part of the site.

· Downtown Waterfront. Linking the waterfront park between Commercial and Long Wharves to Government Center by a traffic free pedestrian mall. This can be realized if the central artery is depressed as proposed.

· Belle Isle Marsh - Protection

· Constitution Beach, East Boston - Improvement of water quality to protect the beach.

· Dorchester Bay - Public control of the coastline and the design of a Dorchester Bay Reservation from South Boston to Tenean Beach.

· Mainside Park, Hingham - Development of the park as proposed by the town of Hingham.

· Nantasket Beach, Hull - That the open space/recreational value of the beach be protected from incompatible nearby development and that maintenance be improved.

58. In September 1976, the Boston Redevelopment Authority produced the Boston Urban Wilds Program.1/ This identifies 573 acres of shoreline property along the harbor to be either developed as parkland or protected as a conservation area. These are included in Figure B-4. In addition, the City of Boston2/ is acquiring an 11-acre site to develop a waterfront park at the corner of Summer and New Streets in East Boston. The city is also planning a small park where the Charlestown Bridge abuts Charlestown, an extension of the existing North End Park towards Charlestown Bridge and a small park on Fork Point Channel in front of the relocated Children's and Transportation Museum. A large waterfront park is currently under construction on the Little Mystic Channel in Charlestown.

1/ Boston Urban Wilds - A Natural Area Conservation Program - Boston Redevelopment Authority, September 1976.

2/ Oral Communication from the City of Boston, Conservation Commission.

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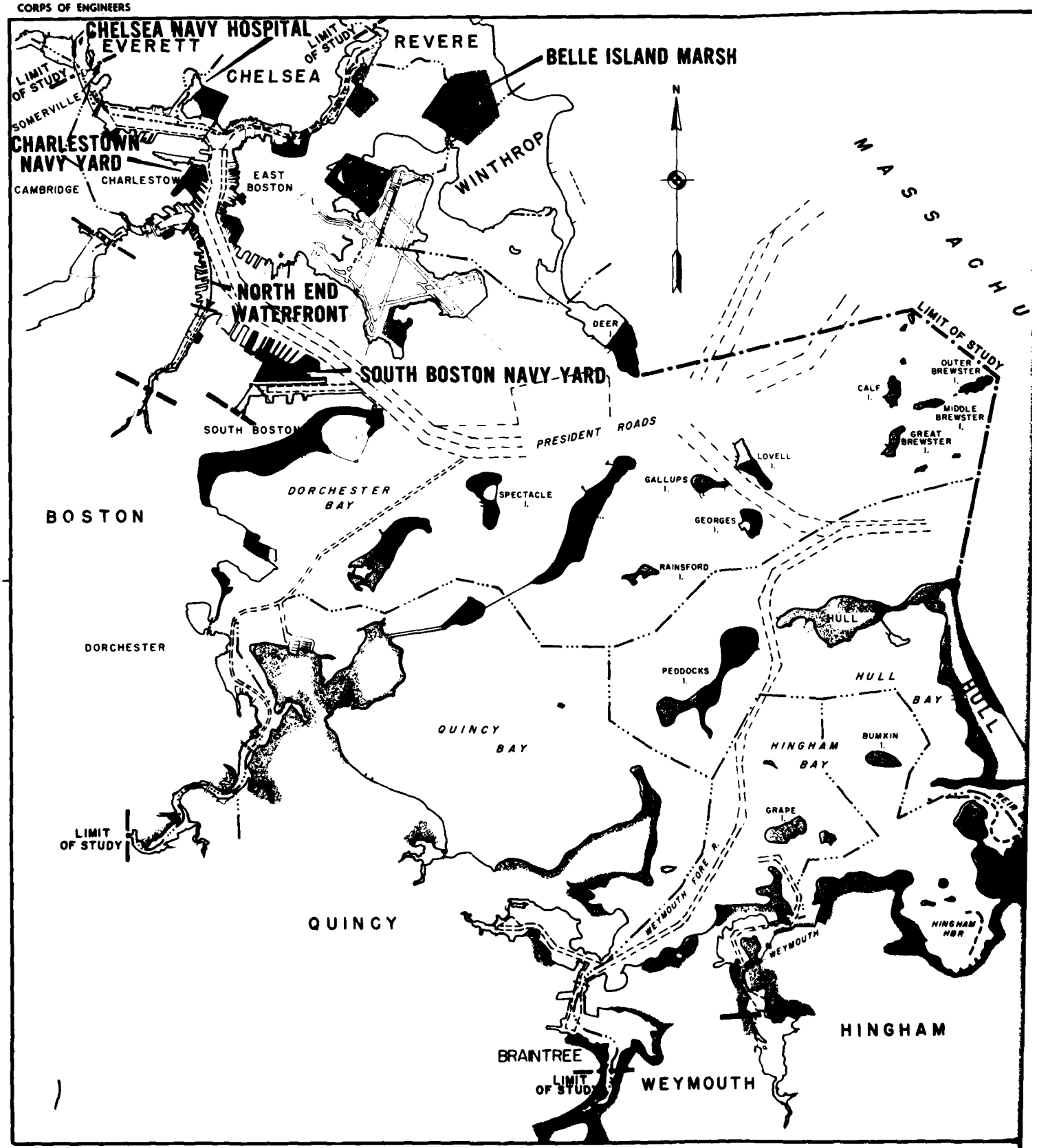

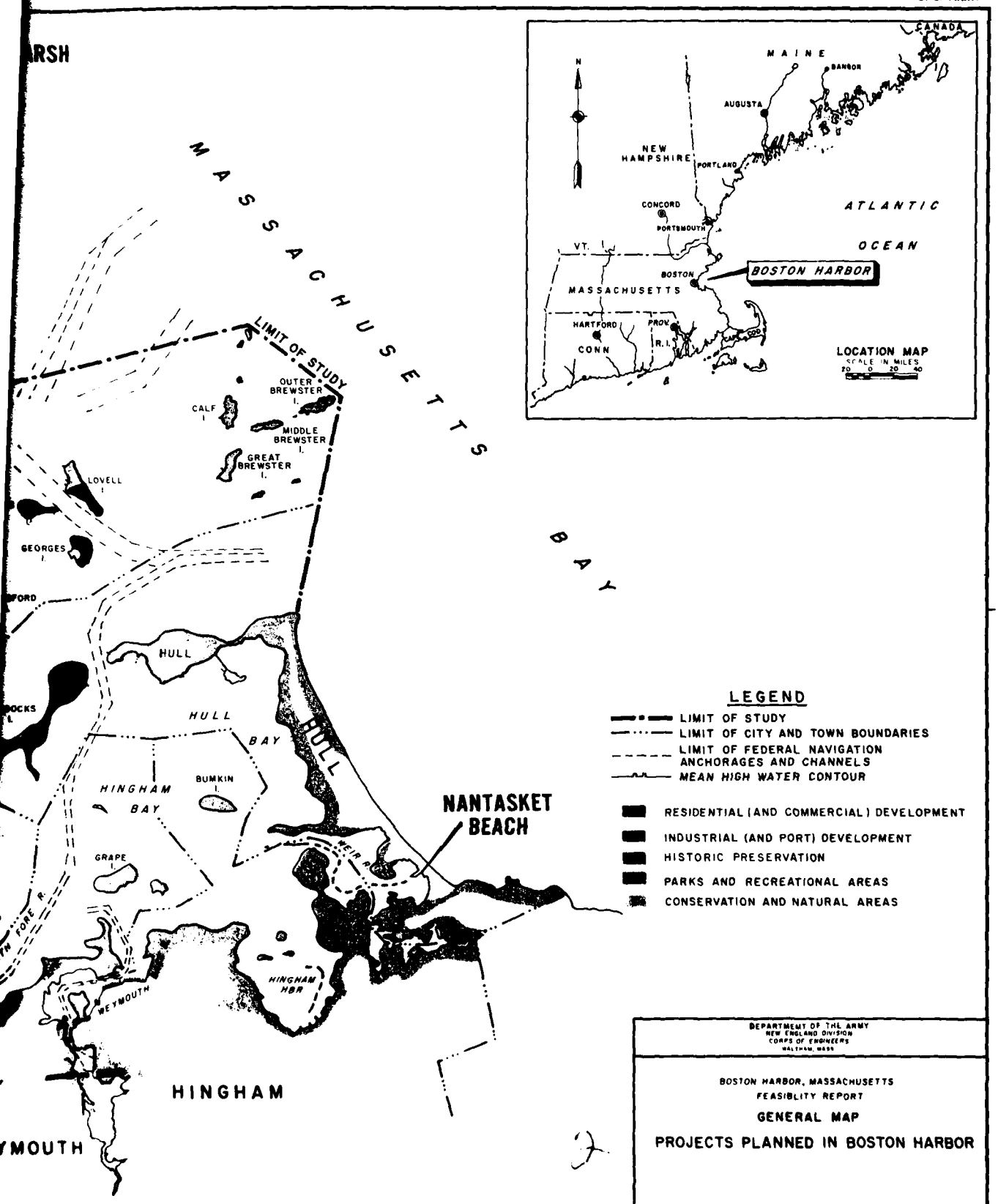

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

BOSTON HARBOR, MASSACHUSETTS
FEASIBILITY REPORT

GENERAL MAP

PROJECTS PLANNED IN BOSTON HARBOR

APPENDIX I FIGURE B-4

Development of Recreational Boating

59. Recreational boating is one of the fastest growing outdoor activities in the United States. There were nearly nine million recreational boats in use across the nation in 1971.1/ According to the Boating Almanac, there are twenty marinas offering 1900 slips and 500 moorings around the harbor. In addition, there are 42 yacht and sailing clubs offering moorings and twelve public and private boat launching ramps.

60. The moored fleet (see Table B-4) is estimated at 6700 boats and an average of 800 transients (visitors and boats launched from ramps) are estimated to use the harbor daily during the boating season. The number of boats at private marinas was estimated from the figures in the Boating Almanac. These figures were increased by 12%, based on the findings of a recent study2/ that the Almanac listings were 12% low due to the lag between preparation and publication and reduced by 5% to allow a vacancy rate. The number of boats moored at clubs was calculated on the basis of information obtained during a telephone survey of the clubs. The number of boats launched at the ramps was calculated on the basis of information obtained during a telephone survey of the clubs. The number of boats launched at ramps was calculated by assuming that each ramp had 110 parking spaces (see ref. 3/ page 35) and that each was two-thirds full on weekend days and one-tenth full on weekdays. The number of visitors was calculated from information obtained from clubs and marinas.

61. Figures obtained from the National Association of Engine and Boat Manufacturers (see Appendix 2, Table B-2) indicated that the number of boats registered in the Commonwealth increased at an average exponential rate of 5.58 percent between 1966 and 1976. As the rate of population growth in Boston and the Commonwealth as a whole were approximately equal, it is believed that this rate represents the rate of growth of the harbor fleet.

62. There are a number of factors which will affect the rate of the future growth of the recreational fleet in the harbor. One example

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1/ National Association of Engine and Boat Manufacturers, Boating 1971, Greenwich, Conn. (1972)

2/ Boating Almanac 1977 - Volume Massachusetts, - Maine, - New Hampshire. Boating Almanac Co., Inc.

3/ Storey D.A. The Massachusetts Marina Boatyard Industry 1972-1973 Mass. Agricultural Experiment Station, U. of Mass., Amherst Bulletin No. 612, October 1974.

is population growth, projected to increase at the same rate of approximately 1.0 percent until 1990, and then to slow to about 0.75 percent between 2000 and 2020.4/ Others are personal income, which is projected to grow at an annual rate of 4.5 percent to 1980 and then to drop to about 3.0 percent by 2020 4/, and the relative cost of boating. With increasing production rates, the cost of boat purchase and maintenance may be expected to decline significantly, while the cost of fuel will increase, as will the cost of moorings as the amount of available space diminishes. Modern boats with hulls of fiberglass and other relatively new materials last longer than older boats built in wood, which tends to increase the fleet size while new boats are added and old boats are not retired. As boating becomes more popular the harbor will become more crowded and less pleasurable, leading people to seek more distant waters, or alternative activities. However, the greatest limitation on growth is likely to be available space for moorings, which will be controlled by the Coastal Zone management planning activities of the Commonwealth. This could be overcome, to some extent, by on-land storage of boats.

63. On the basis of the evidence available, it appears likely that the harbor fleet will continue to grow at the present rapid rate for a number of years, and then the growth rate will start to decline as moorings come into short supply. This will put pressure to increase the transients launched from ramps, mainly outboards. Further leisure time will increase both as the proportion of the population which is retired increases, and the working week decreases. This is likely to lead to increased usage of recreational boats.

4/ OBERS Projections: Regional Economic Activity in U.S., 1972 Series E, U.S. Water Resources Council 1974.

TABLE B-4

BOSTON HARBOR RECREATIONAL BOATING FLEET-1977

	Inboard[1]	Outboard	Sailing	Unspecified	Total
Permanent Fleet					
Moored at Marina	1334	641	590		2565
Moored at Yacht Clubs	1753	1163	646	590	4152
	3087	1804	1230	590	6717
Average Transients					
Launched from ramps	35	244	69		470
Visitors from sea	216	126	87	41	348
	251	370	156	41	818
Total Fleet	3338	2174	1392	631	7535

1/ Includes Inboard/Outboard

SECTION C

PROBLEMS AND NEEDS

PROBLEMS AND NEEDS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

SECTION C

PROBLEMS AND NEEDS

1. This section of Appendix I discusses the problems and needs associated with the removal of sources of floatable debris from Boston Harbor. Information is presented in relation to past and present plans for debris collection and removal in the harbor. The discussion describes the sources of debris and how they have developed. The changes in industrial and cargo handling practices which have been largely responsible for creating the present situation are described in Section B, "The Changing Setting of the Harbor". The needs for action by removing the large numbers of dilapidated, largely abandoned piers, sunken vessels, and piles of floatable debris which are to be found littering the shorefront, particularly the inner harbor, are described.

2. The total amounts of debris are indicated and the volumes to be found in each community are shown in Table C-1. The great bulk of the debris can be found in the inner harbor, particularly within the city of Boston.

3. The removal of debris sources will result in two major benefits. The first will be an improvement to navigation, particularly for recreational boats, through the reduction in the amount of damage resulting from boats hitting floating debris produced by the slow break-up of the rotting piers, abandoned vessels and shorefront dumps. The second benefit will be through the enhancement of shorefront properties resulting from the removal of an eyesore and a reduction in the cost of redevelopment. This will undoubtedly assist the city of Boston in realizing the plan for urban renewal. The Mayor of Boston has requested that action be taken to remove derelict structures within the harbor.

Status of Existing Plans and Improvements

4. The Commonwealth of Massachusetts received authority in 1971 to clean up state waterways. Funds have been made available and contracts averaging $50,000 annually have been awarded to clean up Boston Harbor. Most of these funds have been spent on picking up existing floating debris.

Revised May 1980

TABLE C-1

SOURCES OF DEBRIS

Community	Waterfront Structures No.	Waterfront Structures Vol. of Debris cu. ft.	Timber Vessels No.	Timber Vessels Vol. of Debris cu.ft.	Loose On-Shore Debris No.*	Loose On-Shore Debris Volume cu. ft.	Total Volume
Hull	22	30,850	1	100	32	11,900	42,900
Hingham	21	267,375			21	28,100	295,500
Weymouth	11	6,310			21	16,400	22,700
Braintree	2	100			1	200	300
Quincy	18	59,800	10	23,200	7	6,000	89,000
Boston	144	1,940,500	36	196,600	59	66,200	2,203,300
Cambridge	2	4,300					4,300
Somerville	1	9,400			1	2,000	11,400
Everett	3				5	9.000	183,700
Chelsea	27	223,450	4	47,700	14	37,400	308,600
Revere	3	3,800	3	3,000	3	1,500	8,300
Winthrop	8	26,000	1	1,000	4	2,300	29,300
Totals	262	2,746,585	55	271,500	168	181,000	3,199,300

*Number of Locations

5. A number of waterfront sites and areas around the harbor have been redeveloped, necessitating the removal of most or all of the debris around the site. In particular, there has been the major rehabilitation of the North End waterfront in the center of Boston. This area has been excluded from the scope of the study for this reason.

6. Other redevelopment projects which have recently been completed, and which have removed major sources of debris, are the Shore Plaza East apartment complex and Mario Umana School in East Boston.

7. There are plans to redevelop the South Boston Navy Yard which is likely to require the removal of a number of dilapidated piers. There are also plans to redevelop the Charlestown Navy Yard, which would remove a number of wooden piers that have the potential of becoming sources of debris. Neither of these plans have been authorized to date.

8. Essentially these projects are all part of urban renewal efforts by the city of Boston. These commenced earnestly in the early 1960's with two major projects in the center of Boston, the Prudential Center and Government Center. After initially concentrating on the rehabilitation of the city center, Boston has spread its efforts to include outlying city neighborhoods and to try to increase employment opportunities for city residents. Redevelopment of the South Boston Navy Yard, which is being acquired by the city for waterfront oriented industrial uses, is a major part of its effort to increase employment. Charlestown has been subject to considerable rehabilitation work since 1965. Redevelopment of the Charlestown Navy Yard as a historic site and park, combined with residential, commercial, and light industry, is likely to be the culmination of this effort. This project is likely to be financially viable in view of the rapidly rising local real estate prices.

9. As described, waterfront (and near waterfront) redevelopment has already commenced in East Boston. However, the construction of new residential units still requires considerable government subsidy to be viable. Possibly, the considered cleanup will prove to be the stimulant unsubsidized private harbor development.

10. There are also a number of other plans for redevelopment of waterfront sites around the harbor, as shown on Figure B-5, which would result in the removal of some debris and debris sources.

Sources of Debris

11. As described in Section B under "The Changing Setting of the Harbor", changed waterfront uses have led to the abandonment of a large number of piers, wharves and bulkheads, particularly in the inner harbor. These have rotted and reached various stages of collapse due to lack of use and maintenance. Other structures have deteriorated while still in service due to lack of maintenance. Some have been converted to some marginal use, such as the storage of debris or scrap, for which it is unnecessary and uneconomic to maintain them adequately, and have been allowed to deteriorate to the point where it would be uneconomic to repair them. As they collapse, these mainly wooden structures break up and float into the harbor. In addition, a number of wooden vessels which were abandoned and allowed to sink in different parts of the harbor also contribute to the floating debris. There are also five shorefront dumps in the study area, all located within the city of Boston. While these seemingly unauthorized dumps have been identified, located and recorded in this report's inventory of debris sources, Appendix 4, page A-1, the 1977 inventory update found each of these five dump areas no longer to be a potential source of floatable debris. Field examination revealed that each dump is composed of non-floatable material and/or rubbish material and the latter is not considered a hazard to navigation. Therefore, no further consideration has been given to shorefront dumps in this report.

12. A total of 262 structures have been identified as being so dilapidated, in part or whole, as to be uneconomic to repair. It is proposed to remove and dispose of these structures, while leaving those which can be economically repaired. Forty-nine sunken wooden vessels and 168 piles of loose on-shore debris have been located around the harbor. The total volume of debris from these sources is estimated to be about 3,200,000 cubic feet. The breakdown of these debris sources is shown in Table C-1, The removal effort also include non-floatable materials that form some portion of certain dilipidated structures as well as materials confined within the hulls of wrecked vessels. The amount of non-floatable materials totals about 4,500 tons. An inventory summary by community is provided in Appendix 1. About three quarters of these debris sources are in the inner harbor.

Debris as a Hazard to Navigation, Visual Blight and Discouragement to Development

13. The continual collapse and breakup of wooden structures, sunken vessels and piles of debris leads to the filling of the harbor with floating objects which is a serious hazard to general navigation and impedes the normal development of recreational boating. The rate of disintegration of debris sources and generation of floating debris is believed to be greater than the rate of removal through natural tidal flushing in the harbor.

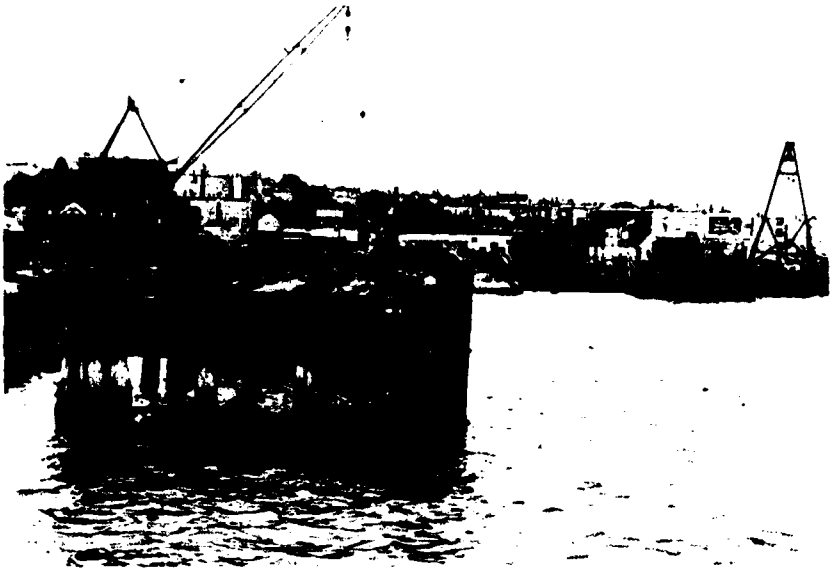


Figure C-1: Residential Area of Eagle Hill, East Boston, cut off from harbor by derelict piers and piles of debris.

Figure C-2: Mario Umana School, East Boston, on site of derelict pier.

Figure C-3: East Boston - Dilapidated pier and warehouse near site of planned Summer Street Waterfront Park and with new apartments for elderly in background.

Figure C-4: Shore Plaza East, East Boston. Recently completed middle and low income apartments on East Boston Waterfront, replacing dilapidated piers.

14. There is a modest program for the removal of floating debris from the waters of Boston Harbor by the Corps of Engineers. In addition, the Massachusetts Department of Environmental Quality Engineering, Division of Waterways, has awarded contracts for the clearance of floating debris in Boston Harbor.

15. These programs cannot hope to keep the harbor clear unless they are greatly expanded. There are no funds authorized at present to allow for such an expansion.

16. As previously explained, virtually the whole inner harbor waterfront has been developed for industrial, commercial and military uses at some date. Changed modes of transport and industrial practices have reduced the demand for waterfront sites, and the major military installations have been decommissioned. This would clearly indicate the need for changing land use along the waterfront. An attractive harbor is a major scenic asset to a city and an obvious focus for residential redevelopment if the city is to be revitalized.

17. The city of Boston has made a major effort towards urban renewal since 1960. There has been major redevelopment in the city center. The North End waterfront, adjoining the center, has been incorporated into this redevelopment with great success, as previouly described. The city is now turning its attention to outlying areas, and also to providing blue collar employment to replace some jobs lost through decreasing waterfront activity.

18. East Boston, which has nearly thirty percent of the debris sources, is a prime area for residential redevelopment along the waterfront, as foreseen in the Boston General Plan. With its view over to Charlestown and Central Boston, it has great scenic potential from the Andrew B. McCardle Bridge to Jeffries Point. This redevelopment can be comfortably accommodated with existing industrial facilities as demonstrated by the fact that houses in the Jeffries Point District, which are worth an additional $8,000 because of their view of Central Boston, directly overlook the Bethlehem Shipyard. However, from the Massport East Boston Pier on, the waterfront is dominated by the desolation of abandoned piers and derelict buildings. The nearer residences are to the waterfront, the more rundown they appear. The appearance of the area is a major disincentive to redevelop. Some new apartments have been built, but only with government subsidies. Any private developer considering construction on the waterfront is faced with both the cost of clearing the site and with prospective occupants who will object to the unsightliness of neighboring properties. Removing derelict piers would eliminate a major portion of this visual blight and disincentive for redevelopment.

Figure C-5: Loose Debris on Shorefront

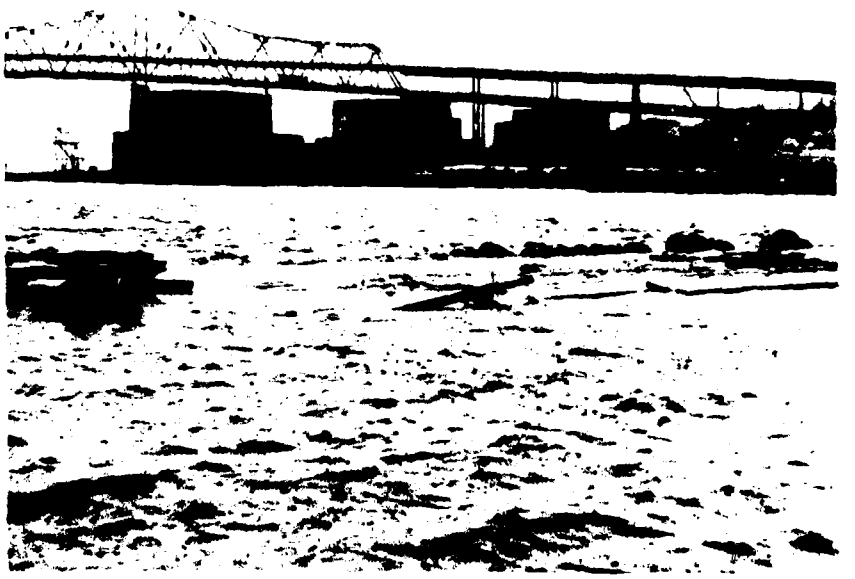


Figure C-6: Sunken Barge

20. In some outlying areas the removal of dilapidated piers will have little impact on surrounding property. They may be small and isolated and appear "quaint" in their setting. Land use on the abutting property may not be impacted by their existence. They may still be used as either storage areas for scrap and debris or to tie floating docks at marinas. However, the vast majority of the debris sources do present a major disincentive to redevelopment of adjoining properties and their removal is an essential step in the renewal of the neighborhoods surrounding them.

21. A survey of boatyards indicated that recreational boats suffered approximately $280,120 in damage in 1976 as a result of boat/drift collisions. In addition, there was considerable unquantified economic loss represented by unreported repairs carried out by owners or at inshore marinas, personal injury and loss of boat use while under repair. Table C-2 indicates the breakdown of reported repairs by boat types. As might be expected, motorboats sustain a higher collision rate than sailboats. Ship repair yards and boatyards did not report any repairs as a result of boat/drift collisions to commercial vessels.

TABLE C-2

1976 BOAT/DRIFT ACCIDENT DISTRIBUTION

	BOAT TYPE				
	Inboard	Outboard	Sailboat	Unspecified	Total
Boat/Drift Incidents in 1976	86	55	9	186	336
1976 Boat Fleet Distribution[1]	3162	2059	1318	598	7137
Percent of Fleet Damaged[2]	5.57%	5.51%	1.39%	-	4.71%
Average Cost of Repair	$428	$255	$300	$842	$625
Total Cost of Repair[3]	$49,075	$18,665	$3,580	$208,800	$280,120

1. 1977 figures from Table B-4 reduced by 5.58% to allow for growth and are reflected in 1976 Boat Fleet Distribution above.

2. Incidents to types of boats have been apportioned.

3. See Appendix 2, Part B, Page B-3.

SECTION D

FORMULATING A PLAN

FORMULATING A PLAN

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES - cont.

SECTION D

FORMULATING A PLAN

1. Formulation involves the determination of possible alternative strategies for ridding Boston Harbor of its floating debris, their evaluation, and the selection of the plan which best meets the goals of national economic development (cost-effectiveness), environmental quality, social well-being, and regional development.

2. The formulation of the best plan involves a two stage screening process. In the first stage, each alternative is screened as to its feasibility from a technical, regulatory and commercial standpoint. All impracticable strategies are rejected and given no further consideration.

3. Each feasible alternative is then fully evaluated in terms of the criteria listed in paragraph 1, and the best plan selected. As will be seen, the selected plan, which is to remove all the sources of debris and to place the debris in a privately owned sanitary landfill in Marshfield, best meets all goals. As a result, no trade-off between different goals is required.

Evaluation Criteria

4. As the evaluation of alternative strategies was done in two stages, two sets of evaluation criteria were adopted. The first set deal entirely with feasibility. The second set consists of technical, economic, and environmental criteria developed in accordance with Water Resource Council's "Principles, Standards, and Procedures for Water and Related Land Resources", of 25 October 1973, which are aimed at developing a plan which best responds to the problems and needs identified by the affected parties.

First Stage - Feasibility Criteria

5. The following criteria were adopted for first stage screening:

a. Is the method of removal and disposal technically feasible using equipment and technology available in the project area?

b. Is the method of removal and disposal allowable under federal, state and local laws, regulations and ordinances?

c. Is the method acceptable to the general public so far as can be established?

d. Can a point of final disposal be located, e.g. incinerator, landfill site, etc., or market, since the re-use of debris is being considered?

Second Stage - Technical, Economic and Environmental Criteria

6. These criteria have been developed in accordance with the format suggested by the Corps of Engineers Regulation No. 1105-2-921 of 10 November 1975, "Feasibility Reports - System of Accounts." They are detailed in the display shown in Appendix 3. They will identify the National Economic Development Plan and the Environmental Quality Plan. They answer the following general points:

a. Technical. Can the alternative be carried out using standard engineering methods and equipment available in the region?

b. National Economic Development. The benefit to cost ratio must be greater than one, if the plan is to be acceptable.

c. Environmental Quality. Positive and negative impacts on water quality, air quality, noise, ecology, land use, and aesthetics. Compatibility with local and regional land use plans.

d. Social Well-Being. Benefits to different income groups, impacts on education, recreational and cultural opportunities, impacts on population, community cohesion, urban renewal, employment and the generation of taxes necessary to support these communities.

e. Regional Development. Impacts on port operation adn the development of the Metropolitan Boston Area.

Possible Solutions

7. The first possible solution is to take no further action than is being taken at present to remove derelict structures and to collect floating debris. This is the no action alternative, and the base against which all positive strategies may be compared.

8. There are three elements of each positive strategy; namely, the collection of floating debris to be found in the harbor at present, the removal of the sources of this debris and the final disposal of the debris. The selected plan will consist of a combination of these elements.

Collection

9. Collection consists of the picking up all items of debris found floating in the harbor and transporting them to a collection point for hauling to their final destination. All plans are based on the use of a tow boat, barges, and hoists to pull the debris out of the water and transport it to a collection point.

Removal

10. The removal consists of breaking up dilapidated piers or dilapidated portions of piers, sunken vessels and piles of debris. There are different methods of carrying out this task. The plan does not need to define precisely the actual method of demolition, as this is best selected by the demolition contractor in accordance with the equipment available to him.

11. The removal plan used for evaluation is based on the use of a caterpillar mounted hydraulic clamshell and shallow draft barges. The clamshell grabs pieces of superstructure, sunken vessels, or loose debris, breaks it off and loads it onto a barge, which is then unloaded into a staging and transfer area or directly onto a burn barge.

12. Piles can be pulled intact directly by the clamshell when they are in soft ground, or with the aid of a vibrator attached to the clamshell when deeply embedded in substrata. Piles will be pulled intact in all areas except where it is determined that no reconstruction or dredging will be required at a later date at the location of the pile; for example, if the shorefront is to be redeveloped for residential use or as a park. Where it is determined that the piles need not be pulled intact, the contractor will be allowed to break them off at ground level at his option. If it is determined that pulling the piles could endanger a nearby structure, the contractor may be required to cut them off at ground level. This clamshell may work off the land, a pile of debris or a barge, whatever is most convenient. It has been used successfully for the removal of dilapidated piers and sunken vessels in New York Harbor as shown in Figures D-1 and D-2.

Figure D-1: Barge Mounted Clamshell Picking Up Debris in New York Harbor

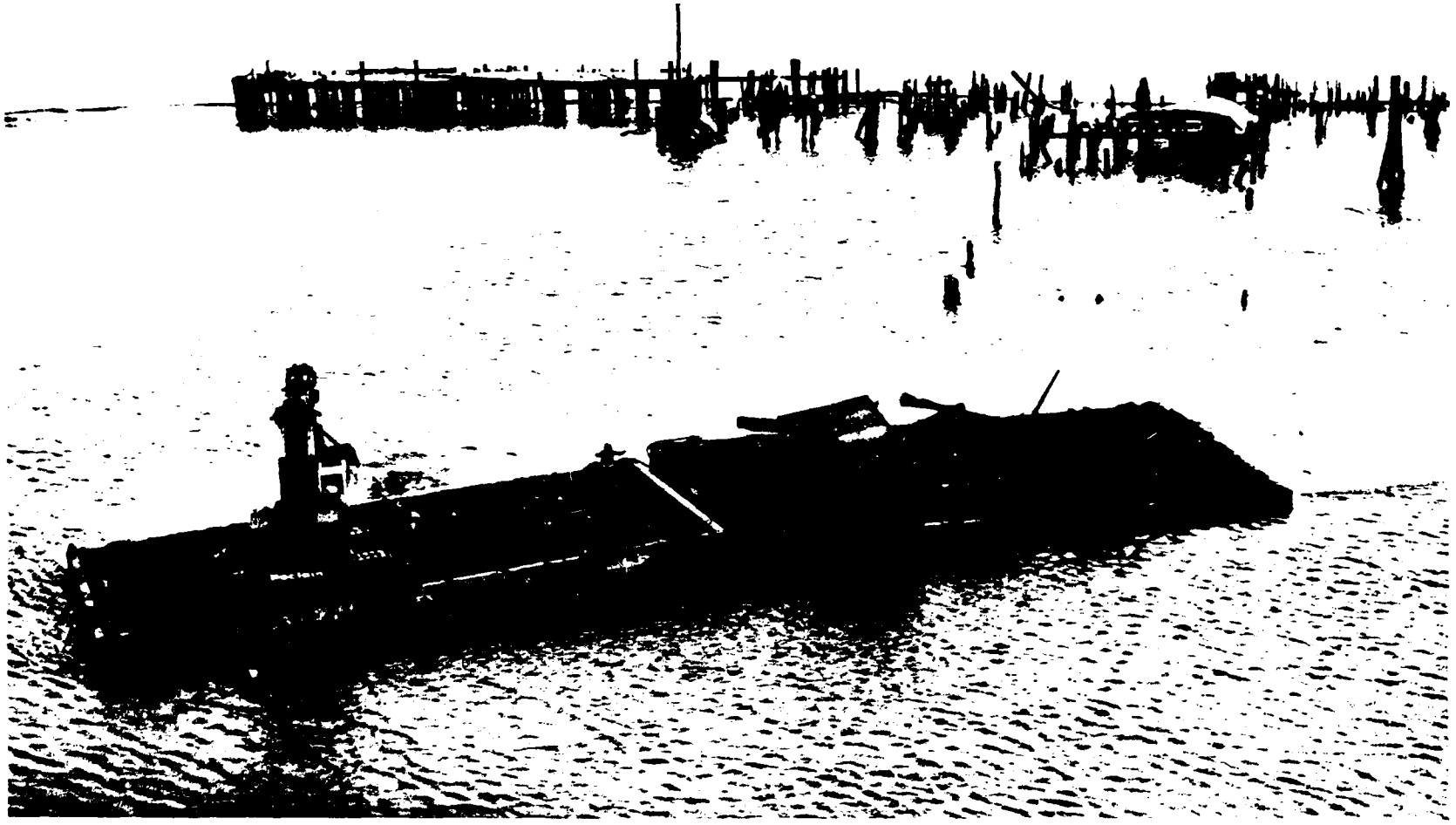


Figure D-2: Barge Mounted Clamshell Pulling Up Piles in New York Harbor

13. Alternatively heavy equipment could be used. This equipment could be mounted on a deeper draft barge, which requires a clear water depth of up to fifteen feet. This will require dredging at shallow sites to gain access to debris sources. However, this removal alternative appears unlikely due to its environmental impacts and higher costs.

Disposal

14. Disposal alternatives are divided into three classes, namely destruction of the debris by burning, re-use of the debris as a source of lumber or energy or disposal by landfill.

15. The following alternatives have been considered.

a. Destruction:

(1) Open Burning on Site. This involves using a debris site, or sites, for open burning, burning the debris and disposing the ashes.

(2) Burning in an Open Pit at a Community Landfill. This involves finding a landfill site willing to accept and burn the debris.

(3) Burning in an Incinerator. This requires finding a licensed incinerator willing to accept the debris for burning.

(4) Burning on Barges within Study Area's Waterways. This involves loading the debris onto a licensed burn barge and burning it within the harbor.

(5) Burning on Barges and/or Vessels in the Open Sea. This involves loading the debris onto a licensed burn barge or vessel and burning it at sea. The burn barge could either be loaded in the harbor from barges towed to it or brought to a staging point for loading between burns. Burning would take place about twenty miles from land and would be prohibited when the wind direction would carry smoke towards the coast.

b. Re-use

(1) To Produce Useful Energy for Power Plants, Heating or Industrial Processes. This involves finding a furnace capable of accepting debris for the production of useful heat. This includes incinerators to supply energy for raising steam or other purposes.

(2) As Domestic Firewood. This involves locating a distribution system to accept, process and market the debris for use as firewood.

(3) To Manufacture Wood Chips and Mulch. This requires the location of a plant capable of reducing the debris to wood chips or mulch and distributing the product. The plant has to be technically capable of handling debris which is unpredictable in shape and condition, likely to be full of bolts, nails or other ironmongery and has been impregnated with creosote. The plant must be able to market or dispose of the chips and mulch.

(4) To Manufacture Hardwood. This requires sorting sound wood from the debris, removing all bolts, nails, etc., drying it, measuring it and cutting it into useful sizes of lumber and marketing it. The fact that most waterfront debris is impregnated with creosote limits the use to which it can be put. The fact that it would have to be sold as secondhand lumber limits the market.

(5) To Manufacture Paper Pulp. This requires the reduction of the wood to chips as for b(3) above. The chips then have to be processed by a paper mill which is capable of handling the different types of wood included in the debris and the creosote.

(6) To Manufacture Charcoal. This requires cutting the debris into small pieces, reducing it to charcoal and marketing it.

(7) As Scrap Lumber. This requires the debris to be sorted into sound and unsound wood, prepared to a condition where it can be marketed and the finding of a way of marketing it.

(8) As Telephone Poles. This requires selecting piles of a size, shape and quality acceptable to the telephone company.

(9) As Railroad Ties. This requires sorting out lumber from the debris of a type and quality suitable for railroad ties, to use either on railroads or for landscaping. Nails, bolts and other ironmongery have to be removed, and the debris has to be cut to size and marketed.

(10) For Pallet Construction. This requires sorting sound lumber of a quality and size suitable for pallet manufacture from the debris, removing nails, bolts and other ironmongery, cutting it to size, manufacturing pallets and marketing them.

c. Landfill

(1) Include in an Existing Sanitary Landfill. This requires locating an existing sanitary landfill or landfills capable of accepting the debris.

(2) Bury on Site. This requires using one or more of the existing debris sites as a fill area for debris. As the debris will slowly rot and disintegrate, the debris fill site will not be suitable for construction.

(3) Bury at Another Location. This involves finding a suitable location other than an existing landfill or a debris site where the debris may be buried without causing significant environmental degradation.

Selecting A Plan

16. The selected plan has been determined by a two-stage screening process. Alternatives are screened for viability in the first stage and to determine the most desirable plan in the second.

First Stage Screening

17. Collection - Only one alternative for collection is presented. A number of different methods of picking up floating debris could be adopted which would have equal effectiveness without significant differences in environmental or social impacts. The selected method is considered adequate, but should any contractor propose any equally or more effective method at lower cost with no significant negative impacts, it will be allowed.

18. Removal - There are two alternative strategies. The first would restrict the equipment used to that which would not require deep draft vessels to approach the piers and would require no dredging. This method is being used with success in New York harbor and is therefore proven. The second alternative would be to use heavy equipment mounted on deeper draft barges requiring dredging to gain access to the debris sources in shallow waters. Dredging would have a significant negative environmental impact, both at the point of dredging and at the dumping site for dredged material. There is no indication that the work could be completed more economically using heavy equipment. Therefore, the removal method using a caterpillar mounted clamshell as previously described and shown on figures D-1 and D-2 has been selected at this stage.

19. Should a contractor propose or bid any other method of completing debris removal at equal or lower cost, it will be accepted providing that it does not have a significant negative environmental impact. Should a contractor bid a substantially lower price, based on using heavy equipment and requiring some dredging, the environmental impact of the dredging will be evaluated and will be permitted if it can be justified.

20. Disposal - The alternative disposal strategies previously described have been screened, as follows:

a. Destruction

(1) Burning on site
(2) Burning in an open pit at community landfill

Alternatives (1) and (2) are both prohibited by Massachusetts Air Quality Regulations. It is not considered feasible to obtain necessary variances from the state and all surrounding communities. The Massachusetts Air Quality Control Office indicated that they would probably oppose the issuance of variances and considerable opposition is to be expected from local communities.

(3) Burning in an Incinerator. This is feasible. Operating incinerators willing to accept debris have been located at Saugus and Braintree.

(4) Burning on Barges, within Study Area's Waterways. Prohibited by Massachusetts Air Quality Regulations. It is not considered feasible to obtain necessary variance for the reasons indicated for alternatives a (1) and a (2) above.

(5) Burning on Barges and/or Vessels in the Open Sea. This is feasible. A licensed burn barge is available in Boston which can be towed to an open sea location to burn the debris.

b. Re-Use

(1) To Produce Useful Energy for Power Plants, Heating or Industrial Energy. The incinerators at Braintree and Saugus sell steam used for heating and processes at neighboring industries. This will be part of strategy a (3).

(2) As Domestic Firewood. There is no established distribution system for selling scrap wood as firewood. Dealers of second hand material who were contacted refused to consider harbor debris.

(3) To Manufacture Wood Chips and Mulch. Manufacturers of wood chips and mulch indicated that they would not accept harbor

debris as the iron and steel mixed in as well as the creosote, would damage their machinery. While this alternative has to be rejected as unfeasible at this time, it should be reinvestigated before the project is commenced. The Massachusetts Department of Public Works is planning to purchase machinery to reduce debris to chips but, at the time of writing, they were unable to make a commitment to accept the debris. Machinery is now on the market which can reduce debris to chips even when it contains steel and creosote. When the project is established as a certainty, it is possible that a local entrepreneur would be willing to invest in the purchase of this machinery and to market the product.

(4) To Manufacture Hardwood. Lumber yards contacted will not handle harbor debris due to its unpredictable condition. No market therefore exists.

(5) To Manufacture Pulp Paper. High creosote content makes harbor debris unsuitable for paper manufacture.

(6) To Manufacture Charcoal. Charcoal manufacturers who were contacted indicated that debris was unsuitable for charcoal manufacture due to its high content of creosote.

(7) As Scrap Lumber. Dealers will not handle harbor debris due to its poor and unpredictable nature. It requires too much labor to sort and prepare it to be marketable at an economic price.

(8) As Telephone Poles. The telephone company only uses new poles and will not accept used material for poles.

(9) As Railroad Ties for Railroads or Landscaping. Manufacturers who were contacted indicated that any creosoted material would be unacceptable due to its effect on their cutting equipment. Other material must be in very good condition and free of nails, etc. No market therefore exists.

(10) For Pallet Construction. Dealers will not accept harbor debris for pallet construction. Material which is not creosoted would need to be free of nails, rot and worm infestation. This would require too much labor to sort and prepare it to be used for pallet construction.

(11) As Piles. The market for secondhand piles is saturated at this time. Dealers will not, therefore, accept piles for re-use, even if they are in good condition.

c. Landfill

(1) Include in Existing Sanitary Landfills. Approved sanitary landfill area has been located in Marshfield.

(2) Bury on Site. No locations within the study area were found to be feasible.

(3) Bury at Another Location. No suitable location within the study area was found.

21. On the basis of the preliminary screening, the following alternatives were judged to be feasible:

• Collection

Using tow boat, barge and hoist to pick up debris in the harbor or any other equivalent method proposed by a contractor.

• Removal

Using a clamshell and shallow draft barges to pull piles and collect other debris and bring it to staging and transfer area. A contractor will be permitted to suggest an alternative method, but should this require dredging, an evaluation of cost saving versus environmental impacts will be made before dredging is authorized.

• Disposal

The following disposal alternatives are judged to be feasible:

a(3) Combined with b(1) - Burning at an incinerator and providing useful energy for heating and industrial processes. The two incinerators that have been located are in Saugus and Braintree. Both are capable of handling the debris and provide steam to local industries.

a(5) - Burning on barges at sea. A licensed burn barge capable of handling the debris, taking it to a point at least twenty miles from the coast and burning it has been located in Boston. Assuming that Massachusetts air pollution control laws do not extend this far to sea, there is no legal block to such burning (at this time Massachusetts has declined to state the limits of their jurisdiction). With reasonable control, significant air pollution problems are extremely unlikely.

c(1) - Include in existing sanitary landfills. A suitable privately owned sanitary landfill which accepts construction debris, and which is licensed to, and has indicated willingness to accept harbor debris, has been located in Marshfield.

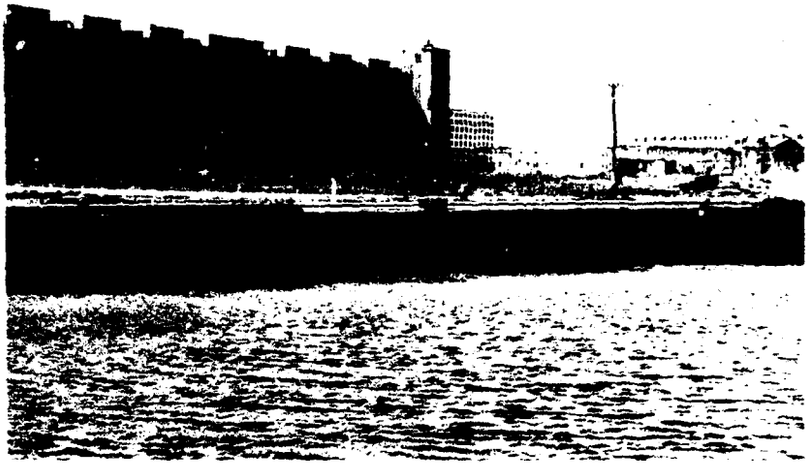


Figure D-4: Proposed Staging Area at South Boston Navy Yard

Figure D-5: Proposed Staging Area of Hingham Industrial Center

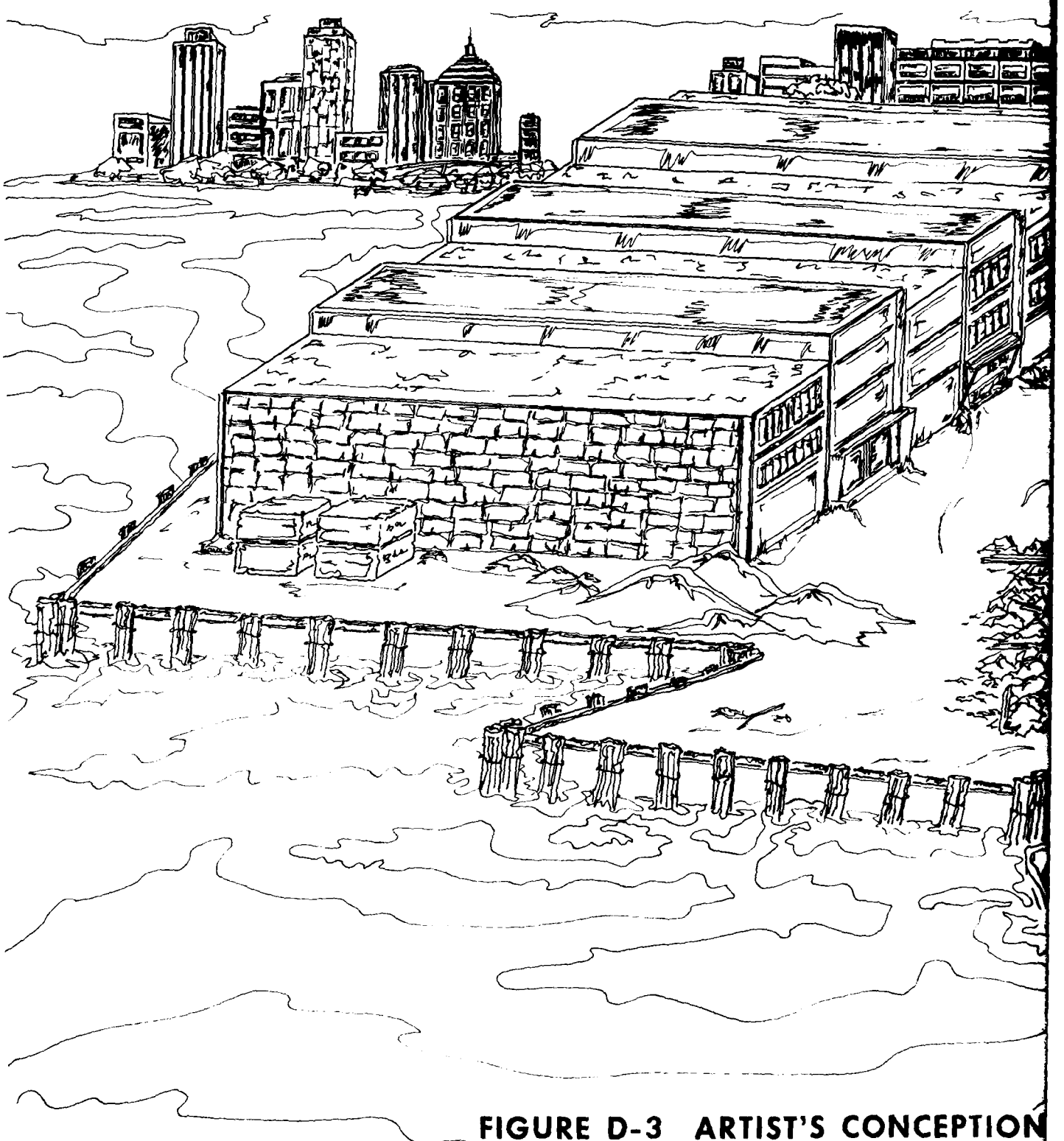
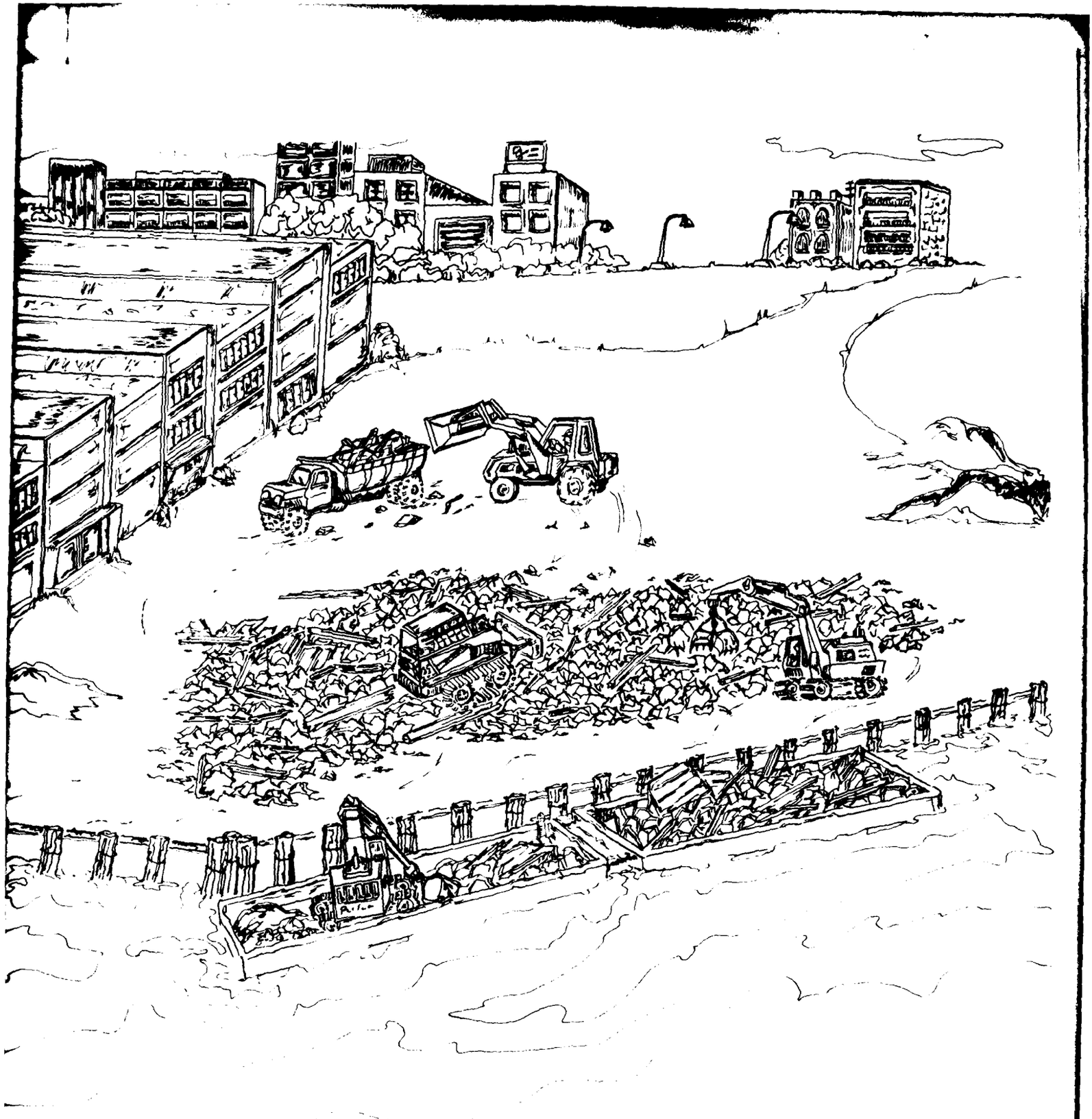


FIGURE D-3 ARTIST'S CONCEPTION
AREA IN OPERATION IN SOUTH B



T'S CONCEPTION OF DEBRIS STAGING
ON IN SOUTH BOSTON NAVY YARD

APPENDIX I FIGURE D-3

22. The use of debris for the manufacture of wood chips has been judged unfeasible at this time since no one could be found willing to make a commitment to accept the debris. It will, however, be reconsidered during the preparation of engineering plans, as at that time either the state or a private entrepreneur may be willing to accept the debris to make wood chips and mulch. Further the market for used piles will be re-investigated.

Second Stage Screening

23. Prior to second stage screening, a comprehensive strategy concerning debris collection, removal and disposal tasks had been developed. Findings indicate that only the disposal options differ, generating three basic alternatives (referenced to as plans 2, 5, and 8 below) and four others that are merely variations of the basic three. Accordingly, eight alternatives including the no action plan were formulated as follows:

Plan I - no Action

This is the base plan. No action will be taken to collect, remove and dispose of floating debris and debris sources beyond such activities as are currently being carried out.

Plan 2 - Collection and Removal: Disposal at Sea with Land Staging and Transfer Area

This plan envisages the collection of existing floating debris and the removal of debris sources using a clamshell and shallow draft barges. The debris will be taken by barge to the South Boston Navy Yard site and transferred directly to the burn barge. If necessary, debris can also be stockpiled at the staging area. The loaded burn barge will be towed to a point over twenty miles to sea from the harbor mouth where the debris will be burnt. The barge will then be towed back for reloading after it has been allowed to cool.

The burn barge is 300 feet long with a 40 foot beam and draws 8 feet of water. It has an air jet ignition system below decks to provide oxygen to the fire. The vessel can safely contain 1000 tons of debris or, assuming the weight of the debris to be 50 lbs./C.F., it would hold approximately 40,000 cubic feet of debris.

Upon arrival of the burn barge at the open sea burn site, emergency warning buoys would be placed around the burn vessel to create a safe zone and to alert other sea-going vessels. The tug boat and crew would be required to stand by throughout the burn. Burning would only be

carried out during favorable weather conditions with prevailing winds away from the mainland.

Figure D-6 shows a burn barge loaded with debris in New York Harbor. Figure D-7 shows a burn in progress.

Plan 3 - Collection and Removal: Burning at Sea with Sea Transfer Description

This plan is identical to Plan 2 except that the burn barge will be loaded directly from the shallow draft barges in the outer Boston Harbor. This requires a clamshell to be placed on a barge and towed to the rendevous site with the burn barge. Once the loading of the burn barge is complete, the clamshell is towed back to the harbor.

Plan 4 - Collection and Removal: Disposal by Braintree Incinerator (one staging area)

The collection and removal of debris will be as described for Plan 2. The debris will be brought to the South Boston Navy Yard where it will be piled and crushed by bulldozer. This will reduce the debris to pieces of a maximum length of 6 feet. They will then be loaded on trucks and hauled to the Braintree incinerator where they will be further reduced to a size suitable for disposal and burnt. The debris would be accepted, including any nails, bolts and other steel hardware.

About six trucks a day would make the journey via the Southeast Expressway (Route 3) and Union Street, Braintree, a distance of about 12 miles.

Major rehabilitation of the incinerator owned by the town of Braintree is nearing completion, and is about to undergo commissioning tests at the time of writing. The incinerator will provide steam to the Weymouth Art Leather Company for heating and processes. The incinerator does not have machinery to reduce the debris to a condition suitable for burning, but the town has indicated that it may purchase the equipment necessary if offered the debris. It has been built to meet all federal, state and local requirements for air pollution control.

Figure D-6: (Top) Loaded Burn Barge
Figure D-7: (Bottom) Burn in Progress on Burn Barge

Plan 5 - Collection and Removal: Disposal by Braintree Incinerator (two staging areas)

This plan is identical to Plan 4 except that an additional staging area at the Hingham Industrial Center is used. Approximately ninety-three percent of the debris, mainly from the inner harbor, will be brought to the South Boston Navy Yard and seven percent, from the outer harbor, to Hingham.

Trucks from Hingham would be routed along Bridge Street, North Street, Commercial Street, and Union Street to the incinerator. On the average six trucks per day would use this route during the time that the debris in the outer harbor is being cleared.

Plan 6 - Collection and Removal: Disposal by Saugus Incinerator (one staging area)

This plan is identical to Plan 4 except that debris will be taken to the Saugus Incinerator instead of Braintree.

The trucks would be routed through the Central Artery to Route I-95, to Route 60, to Route 107 to the incinerator, a route length of approximately 13 miles.

The Saugus incinerator is privately owned and located on the Saugus River just east of Route 107 in Saugus. It can handle the debris as received from the trucks without further processing. It meets with all federal, state and local regulations for the control of air pollution. It supplies steam to the General Electric plant on the north side of the Saugus River for heating, processes, power generation and testing of steam turbines.

Plan 7 - Collection and Removal: Disposal at Marshfield Sanitary Landfill (one staging and transfer area)

Collection and removal would be as described for Plan 2. Debris would be brought to the South Boston Navy Yard where it would be reduced to pieces no longer than 6 feet by bulldozer. This not only makes it easier to bury, but compacts the debris for haulage, hence, reducing the number of truck loads.

The debris will then be hauled to a privately owned sanitary landfill located in Marshfield (see Figure D-10). The route would be as shown on the map. An average of six truckloads a day would make the 32 mile journey to the landfill.

The landfill is owned and operated by Sylvester Ray Enterprises, Inc. It is approved and authorized by the Massachusetts Department of Health. It is located on the site of an old sand and gravel pit. The cell method of landfilling is used, which consists of filling cells, approximately 40 ft. x 400 ft., with alternate layers of debris and fill.

Plan 8 - Collection and Removal: Disposal at Marshfield Sanitary Landfill (two staging and transfer areas)

This plan is identical to Plan 7 except that an additional staging and transfer area is used at Hingham Industrial Center as in Plan 5. There would be an average of six trucks a day making the 19 mile journey to the landfill using the route shown in Figure E-1 during the time that the debris in the outer harbor is being cleared.

Evaluation of Alternative Plans

24. Alternative plan effects are displayed in Appendix 3. This provides a tabular display of different accounts in accordance with Water Resource Council's Principles and Standards for Planning Water and Water Related Land Resources. They are compared below.

Technical Evaluation

25. All the plans are technically feasible. The proposed method of collection does not present any problems. The method of removal has been tried and proven in the clearance of piers and sunken vessels in New York Harbor.

26. The use of the burn barge would be limited by weather conditions in that it could not operate with unfavorable wind conditions or rough seas. Winds are in a westerly direction, or offshore, about 61 percent of the time, and the air is calm about 4 percent of the time.

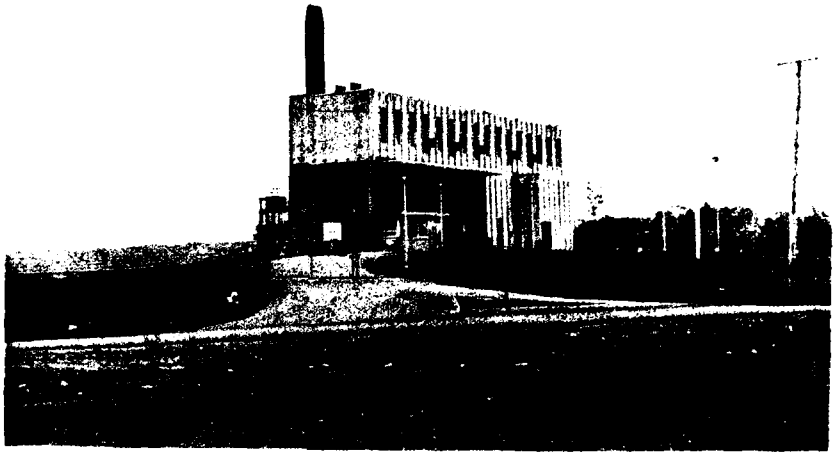


Figure D-8: Braintree Incinerator

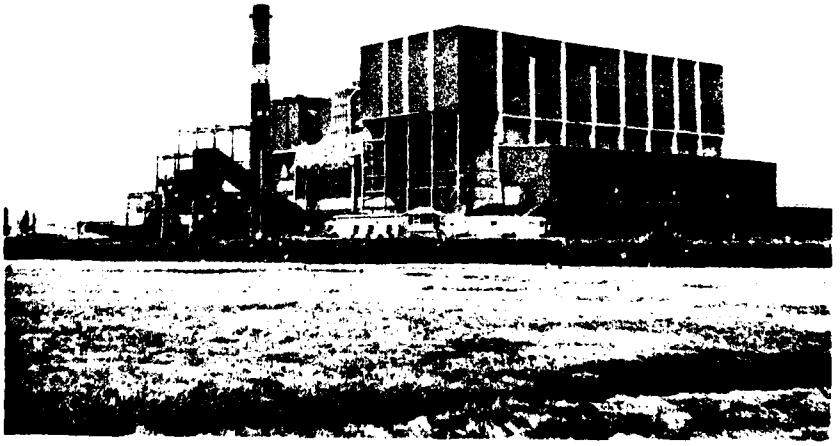


Figure D-9: Saugus Incinerator

27. Reducing the size of debris to pieces of a maximum length of 6 feet by crushing it under bulldozers has been practiced successfully in New York Harbor. Both selected staging areas, South Boston Navy Yard and Hingham Industrial Center, have direct access to the waterfront and easy connections to the highway system. They have areas suitable for piling, crushing and temporary storage of some portion of the debris.

28. The Braintree incinerator is not yet in operation, therefore, its capacity for handling the debris is unproven. It has to break the debris into small pieces to burn it and is not equipped to do so at present. However, there are no reasons to believe that it will be unable to purchase equipment which could handle debris containing nails, bolts, and other non-combustible items, as well as creosote, and break it down to a size which can be burnt, or that the debris will produce particular problems in the incinerator.

29. The Saugus incinerator has been in operation since 1975, and can handle a wide variety of solid waste and consumer durables which are fed to the incinerator and the steel removed after burning. There are no technical reasons why it should be unable to handle debris in the condition in which it is delivered from the staging area.

30. The Marshfield landfill site is totally adequate to handle the debris.

National Economic Development

31. All the action plans will produce equal benefits which will be discussed in Sections E and F. The benefit to cost ratios for different alternatives vary from 0.98 to 1.08:1. While these are not high ratios, they are based on a conservative method of assessing property enhancement values as described in Section F. The figures used are those which can be substantiated by recognized methodologies. There is evidence that a far higher property enhancement figure is likely to result from the removal of debris sources. The cost of implementing the different alternatives varies from $21,368,000 to $19,464,000 with Plan 8 being the least costly.

Environmental Quality

32. This section compares the contribution of each alternative under consideration to the aesthetic, ecological and cultural attributes of the study area.

Figure D-10: Sanitary Landfill Owned and Operated by Sylvester Ray, Inc., Marshfield, Massachusetts

33. The no action alternative would have no direct impact on environmental quality. Conditions would continue much as at the present time, debris sources slowly disintegrating and contributing to the floating debris in the harbor. New debris sources would be created as piers and boats were abandoned. Some debris sources would be cleared to make way for redevelopment.

34. The no action alternative would, however, have an indirect negative impact on the environmental quality of the inner harbor where about three quarters of the debris sources are to be found. It would provide a disincentive to redevelop potentially valuable waterfront sites to provide the basic needs of a community including recreation, housing and employment. It would contribute to the maintenance of the existing drift of population to suburban areas while adding to the pressure to consume open space with the strong negative environmental impacts this entails. It would encourage the dispersal of population, increasing cost of infrastructure such as highways, sewers, and utilities and the cost of municipal services. In particular, such dispersal increases energy consumption in that it results in greater dependence on private transport, i.e. automobiles, as opposed to public transport, and simply walking to neighborhood stores, restaurants and other facilities. Furthermore, movement of population to the suburbs increases the demand for federal funds in the form of grants for sewers and highways. In particular, it will lead to pressure to divert federal moneys intended for the improvement of water quality under the Water Quality Control Act Amendments of 1972, toward subsidizing the development of open space.

35. By comparison, the action alternatives, each of which involves the complete removal of all the sources of debris, will significantly enhance the waterfront in the inner harbor and make it more attractive for redevelopment. It will make for some aesthetic enhancement in the outer harbor. Other impacts of the action alternatives will be relatively minor. Those which are common to all alternatives are described in Section E.

36. The burning-at-sea alternatives involve the release of a large quantity of air pollutants, and some fallout into the ocean. As all the burning will take place over twenty miles from the coast, the impact on any populated area should be negligible. There is, however, a risk of a shift of wind during burning, which lasts five or six days, causing pollutants to be carried towards the shore and populated areas. Burning at sea will avoid the necessity for trucking the debris overland. With an average of six truckloads a day running over major highways, the impact of trucking is not considered to be significant.

37. Burning in incinerators will lead to some release of air pollutants. However, the incinerators will be producing useful energy which would require the burning of fossil fuels if the debris were not available. Therefore, the quantity of net additional pollutants released will be negligible. It is estimated that the burning of 3.2 million cubic feet of debris in these incinerators could conserve about 28,000 tons of coal equivalent fossil fuels.

38. Sanitary landfill will require the use of approximately three acres of land. As sanitary landfill sites are in short supply, this is a significant loss of resources. On the other hand, harbor debris will produce less pollution through leaching than the usual mix of solid wastes sent to a sanitary landfill.

Conclusions

39. Based on a conservatively calculated benefit to cost ratio which is greater than one, and also on an environmental quality analysis which would indicate that the removal of floating debris and debris sources would result in a substantial net environmental benefit, it has been determined that action to clear Boston Harbor would best meet national and regional goals.

40. As Plan 8, the collection and removal of debris and its disposal at the Marshfield Sanitary landfill, which is privately owned by Sylvester Ray Enterprises, has been selected, based on its capability to maximize project benefits without any significant negative impacts when compared to other alternatives. Therefore, it has been selected as the best method of meeting planning objectives.

Completion Time

41. Based on a single crew working, it would take about five years to complete the project. It is assumed that two crews will work continuously and that the clearance of debris sources will be completed in about two and a half years.

SECTION E

THE SELECTED PLAN

SECTION E

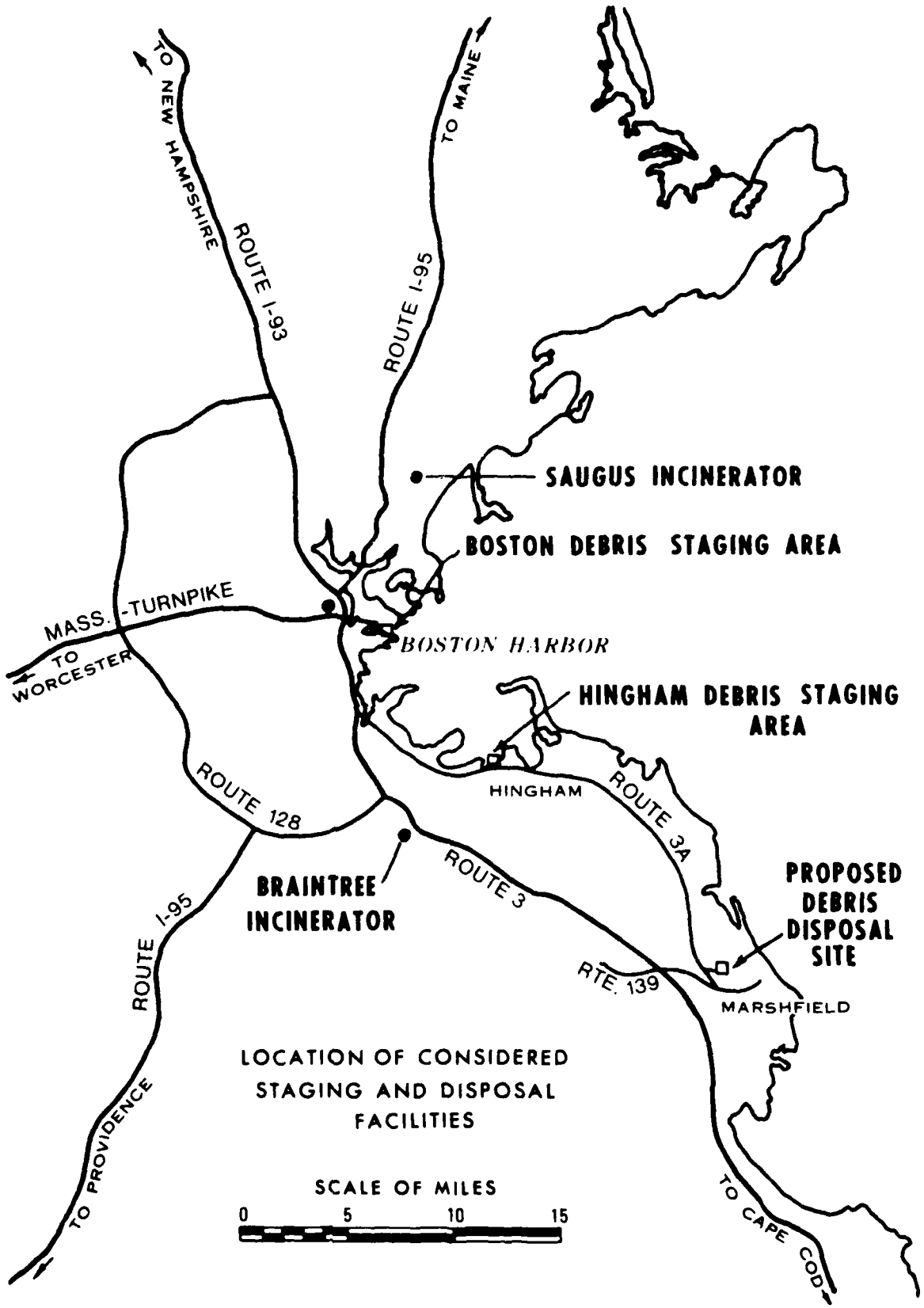
THE SELECTED PLAN

1. This section describes the plan of implementation selected in the previous section. The description discusses the plan elements and its meaningful effects, both favorable and unfavorable. Economic information is presented in Section F.

Plan Description

2. The selected plan consists of clearing Boston Harbor of all existing floating debris hazardous to navigation by picking it up, removing all sources of debris consisting of dilapidated waterfront structures, dilapidated portions of partially dilapidated waterfront structures, sunken wooden vessels and loose onshore floatable debris, and finally burying it at an existing privately owned sanitary landfill in Marshfield. Debris from the inner harbor will be brought via water to a site in the South Boston Navy Yard. Debris from the outer harbor will be brought via water to Hingham Industrial Center. The debris will be reduced in size, trucked to, and deposited at a sanitary landfill in Marshfield. The removal effort also includes non-floatable materials that form a part of certain dilapidated structures as well as materials confined in hulls of wrecked vessels. The plan includes the repair of certain partly dilapidated structures in use that warrant repair. The locations of the major facilities are shown on Figure E-1.

3. A method of collection and removal is described in Section D in order to establish the feasibility of the plan and to estimate costs. The low bidder for the demolition contract will be allowed latitude in selecting a removal method which does not have any significant negative impacts. This is intended to increase competition in bidding. If he selects to dredge in order to gain access to piers with deeper draft vessels, a dredging permit will be required and there will have to be a positive trade-off between the saving in cost and the negative impact of dredging.



APPENDIX I FIGURE E-1

Evaluated Accomplishments

4. The significant evaluated accomplishments that would result from the proposed plan of improvement are:

a. Improvements to navigation and a substantial reduction in boat/debris collisions in Boston Harbor.

b. The enhancement of waterfront sites encouraging redevelopment for the economic and social benefit of the local population.

c. Improvements in existing surrounding residential property values, particularly in East Boston.

d. The completion of one necessary task in the urban renewal program of the city of Boston.

5. The selected plan is expected to reduce the amount of floating debris by 90%, resulting in an annual average saving of $705,000 in repairs due to boat/debris collisions.

6. The calculated value of the enhancement of waterfront sites is estimated as $6,094,891 It is estimated that surrounding residential properties in East Boston will increase in value by $4,753,000. The figures calculated for surrounding residential property enhancement are believed to be conservative. The total increases could be many times this figure if the debris clearance is coordinated with urban renewal work in the area such as improvements in utilities, building of schools and parks, site clearance and the provision of dwelling rehabilitation grants.

7. The other communities with major sections of waterfront on the inner harbor are Everett and Chelsea. Due to the location of the debris sources in an area which has already been redeveloped for nonwaterfront industrial uses, it is to be doubted whether the project will have a significant impact on Everett. In Chelsea the project is likely to promote redevelopment for waterfront oriented industrial purposes on a number of now vacant lots along the Chelsea River bringing much needed employment to the area and tax revenues to the city. It will also enhance the harbor-oriented, privately sponsored renewal work in the Medford Street area of Chelsea, between the Tobin-Mystic River and McCardle Bridges. This renewal, if financially successful, will help promote the planned 1,000 unit proposed residential redevelopment of the Chelsea Naval Hospital site, which is a key to the renewal of the city of Chelsea.

Effect On The Environment

Water Quality

8. If dredging is not selected, the project will have an insignificant impact on water quality. Experience with the ongoing project in New York Harbor indicates that the pulling of piles and removal of sunken vessels causes only a minor disturbance to the harbor bottom. Removal causes some local turbidity which quickly settles out. It is unlikely that the work will cause the release of significant quantities of heavy metals or other contaminants settled in the bottom mud.

9. The inner harbor sediments contain high levels of trace metals in its sediments. Samples1/ taken at the junction of the Island End and Mystic Rivers and at the mouth of the Charles River indicate the following levels of trace metals.

1/ Trace Metal Analysis of Boston Harbor Waters and Sediments. New England Aquarium Research Department.

Metal	Island End River/ Mystic River	Charles River by Charlestown Bridge
Zinc	985 ppm	1360 ppm
Cadmium	7.8	29
Lead	411	595
Nickel	87	75
Chrome	174	116
Copper	357	494
Cobalt	6.8	17.5
Mercury	2.33	5.7
Molybdenum	7.5	14
Vandium	1110	600

10. If dredging is selected, considered highly unlikely, most dredging will be along the Chelsea River and some sites along the East Boston waterfront facing Charlestown where shallows are to be found. Significant dredging is unlikely to be required in other areas of the inner harbor as there is already sufficient depth. Though there are no samples available, it is expected that sediments in these areas will contain similar levels of trace metals.

11. Therefore, dredging is likely to lead to the release of contaminants in the water, both at the dredging sites and the spoil area. In addition, dredging will increase turbidity and release organics which will lower dissolved oxygen levels.

12. It is unlikely that dredging could be justified in the outer harbor since the main debris concentrations are at Hingham Industrial Estate and Town River Bay, Quincy, both areas of relatively deep water. Other debris sources are spread out around the shoreline and it is doubtful if dredging could be justified on the basis of cost. Levels of contaminants are in any case lower than in the inner harbor.

Marine Ecology

13. The removal of sunken wreckage and dilapidated piers by methods not involving dredging should affect the existing biological community only to a minor degree. Organisms living on or within the subsurface sections of the wreckage or piers will be displaced. Sessile forms will be removed from the water with the dislodged material and will subsequently die unless returned to the water. Nonsessile forms will swim away from the site, but a population should resume after operations have ceased.

14. Turbidity should increase to only a minor extent because of the minimal turbulence which will be created by removal activities. Suspension of minute amounts of inorganic and organic material and metals should produce little effect upon the existing environment and organisms.

15. Dredging will directly and indirectly affect the existing biological community. The exact effects will depend on the degree of disturbance, the character of the sediments and the composition of the biotic community.

16. Organisms living on or in the substrate will be killed or otherwise displaced by the dredging activity. Nonsessile organisms should move from the site, but a population should resume when operations have ceased. Dredging will also lead to a lowering of dissolved oxygen levels and an increase in turbidity which may temporarily affect organisms, particularly in the inner harbor.

17. Dredging would also lead to the dispersion of contaminants found in the sediments, which could be taken up by aquatic organisms.

Noise

18. The proposed plan will produce some disturbance due to removal activities near residential areas. Contractors will, however, have to conform to local and state noise regulations and the impact is expected to be minimal. The staging and transfer area in South Boston is located a considerable distance from residential areas. The staging and transfer area in Hingham is within hearing distance of some residences but, at a minimum distance of about 750 feet, noise disturbance is not expected to be significant. An average of six trucks a day carrying debris to the landfill along major roads is not expected to make a significant impact on noise levels.

Land Use

19. The proposed plan is likely to induce beneficial redevelopment of waterfront sites for industrial uses hence, providing employment. The plan also is likely to induce residential and recreational purposes to the general benefit of the population. Such redevelopment will generally conform to local and regional land use plans.

Aesthetics

20. The proposed plan will remove a major visual vlight from the waterfront area, particularly in the inner harbor.

Other Effects

21. The removal of 122 structures and 2 shorefront dumps within the project area might constitute an adverse effect upon significant cultural resources if any of these sites are determined eligible for the National Register of Historic Places. If the project proceeds as planned, a cultural resource survey will examine these sites and evaluate them according to the criteria for eligibility for the Register. If any sites are determined eligible, mitigation will be planned in coordination with the Massachusetts Historical Commission and the Advisory Council on Historic Preservation.

22. Since the proposed Federal action (Plan) will, of necessity occur within the 100-year (base) flood plain, the provisions of EO 11988 (Flood Plain Management), EO 11990 (Protection of Wetlands) and regulations attendant thereto (ER 1165-2-26) have been addressed.

23. There are no "practicable" alternatives to siting, insofar as, since the purpose of the most of these structures is to allow vessels to moor along side. Many of the structures are "in the water" at low tide, others do extend landward to occupy what can ligitimately be called coastal flood plain.

24. The beneficial impacts of debris removal have been treated at length in this study report. There are two adverse impacts which have been identified with implementation of the plan, and these will be discussed herein. The first of these is the possibility of causing additional "wave runup" by the removal of wharves, and other marine structures which presently tend to dissipate some of the kinetic wave energy. Upon further analysis, it becomes apparent, however, that the sturctures to be removed do very little in the way of absorbing wave energy; indeed, they were designed in such a way as to allow most of that energy to pass through or around their supporting members. Since they presently absorb a minimal amount of force, it follows that their removal will have a similarly minimal effect on reducing the wave energy as it impacts the shore.

25. The second and more significant concern is the possibility that removing these marine structures may induce development in the base flood plain, either through improved aesthetic consideration, or more directly by obviating the need for a potential developer to deal with this significant cost item of site preparation. While this is a legitimate concern, those portions of the waterfront that offer potential for flood plain development are extremely limited. Importantly, it is judged that there is sufficient regulatory safe guards in place

at the Federal, State and local level, that it is highly unlikely that any indiscriminate use of this "new" shorefront will take place. Consequently, while the inducement to develop within the base floodplain is very real, the number of sites where it could occur is so limited, and the controls so stringent, that it is judged to be an insignificant adverse impact.

26. Furthermore, the land site earmarked for the disposal of about 3.2 million cubic feet of debris sources (considered the relevant area) is not in a riverine, a coastal floodplain, or a wetland area. Therefore, insofar as these Executive Orders and regulations are concerned, the plan can be implemented.

27. The proposed plan will produce social and economic benefits to the region. It will complete a necessary task in the urban renewal plans of the city of Boston thus advancing the economy and development of the regional capital. It will lower the cost of waterfront redevelopment and will provide an added inducement to draw private investment to the area. It will visually enhance an area of major historical significance and thus promote tourism. It will help in the intended development of Boston Harbor as a major recreational area as planned by the Metropolitan Area Planning Council. 1/

1/ Boston Harbor Islands Comprehensive Plan, MAPC, October 1977.

SECTION F

ECONOMICS OF SELECTED PLAN

ECONOMICS OF SELECTED PLAN

TABLE OF CONTENTS

LIST OF TABLES

SECTION F

ECONOMICS OF SELECTED PLAN

1. Section F addresses the costs and benefits of the selected plan. The following presents the effects of the proposed improvements which can be quantified in dollar terms. Other effects are presented in Section E.

Methodology

2. The economic justification of the proposed debris removal and disposal was determined by comparing the equivalent annual costs with estimated equivalent annual benefits accruing to the project over its economic life. The average annual benefits should equal or exceed the annual costs if the Federal Government is to contribute to the project.

3. Benefits and costs are compared by putting them on an average annual basis at an interest rate of 7-1/8% applicable to public projects.

4. A number of economic and physical forces limit the life of the project, particularly the fact that the dilapidated piers and other debris sources would eventually rot away and disappear, and also inaccuracies in making long term predictions. Based on these factors, an economic life of 50 years was selected for project analysis.

5. The development of costs and benefits follows standard Corps of Engineers practice. All goods and services used in the development of the project are estimated in monetary terms. Benefits are reflected as navigation benefits and increased property values. Navigation benefits result from a reduction in boat/drift collisions due to cleanup. Increased property values result from a reduction in the cost of future development, and from the removal of an unsightly barrier between residential areas and the harbor (see Appendix 4).

Costs

First Costs

6. First costs were estimated for removal, collection, and disposal of all existing and potential debris sources as well as the cost of repairing portions of partially dilapidated wharves which are in use. Removal includes the costs of removal and transportation of structures, wrecks, and on-shore debris to a designated staging area. Collection includes the costs of collection and transportation of drift material floating in the waterways to the staging area. Disposal includes the cost of unloading, processing, and reloading this material at the staging area and of hauling to, dumping and burying it at the landfill site. Table F-1 provides a summary of first costs. Repairs cover the cost of removal, disposal, and replacement of damaged sections of structures which are partially dilapidated and in use. Where the sound portion only is in use and the damaged portion can be removed without detriment to its continued use, replacement is not included in the estimate. Costs of proposed improvements are based on December 1979 price levels. Contingencies are computed at 20 percent of estimated construction costs and supervision, administrative, engineering and design at 13 percent of the estimated construction cost.

TABLE F-1

SUMMARY OF ESTIMATED FIRST COSTS

Removal	$ 9,532,500	
Collection	1,031,100	
Disposal	1,661,900	
Repair of Partially Dilapidated Structures	2,128,800	
Subtotal	14,354,300	$14,354,300
Contingencies @20%		2,871,000
Supervision, Administration, Engineering & Design @ 13%		2,239,000
TOTAL ESTIMATED FIRST COST		$19,464,300

(revised May 80)

Annual Costs

7. Estimated annual costs are based on a 50 year economic life. The investment cost equals the first cost, because benefits are realized immediately and in proportion to the percent of total costs spent. Interest and amortization charges are based on a capital recovery factor of 0.07361. Annual maintenance costs during and after cleanup, estimated at $15,000 are totally a local responsibility. For further details see paragraphs 8 to 11 below. Table F-2 summarizes the annual costs.

TABLE F-2

SUMMARY OF ANNUAL COSTS

ANNUAL CHARGES	
Project Investment	$19,464,000
19,464,000 x 0.07361	1,432,700
Local Maintenance	15,000
	TOTAL $1,447,700

Local Inspection Program and Related Costs

8. *After cleanup as proposed, local interests* agreed to enact and inforce legislation to prevent creation of future sources of harbor drift and debris. Accordingly, the related local inspection effort, described below, was arrived at through analysis of the number (271) and location of remaining waterfront structures, type of inspection and coordination, as necessary, with owners including effected community officials, where structure may warrant repair.

9. The study area (Boston Harbor) comprises a tidewater area of approximately 47 square miles including about 110 miles of shorefront lying landward of a line from Point Allerton at Hull to the tip of Deer Island, Boston. Twelve communities abut Boston Harbor.

10. In view of scope of work involved, a semi-annual inspection by boat should prove quickest, most effective and least costly. Each inspection tour of the harbor should take about 20 days or a total of 40 days annually. Labor and plant would entail one qualified inspector and the rental of a suitable small boat with pilot. On this basis, the inspection program including office supervision and overhead is estimated to cost $15,000 annually.

11. The necessary companion effort "inforcement" would center on debris souce violators, court actions and related cost. However, any estimate of cost concerning enforcement would be based on conjecture. Therefore, no further consideration has been given to enforcement in this report.

Benefits

12. This section of the report presents the benefit analysis to determine the economic feasibility of the proposed removal, collection, and disposal of debris from within Boston Harbor.

13. Benefits derived from the planned improvement consist primarily of navigational benefits and property value enhancement.

In addition to these primary benefits, regional beneficial effects would be realized. These effects, which are not quantifiable, are described in Section E.

Navigational Benefits

14. Navigational benefits result from a reduction in the expected number of boat/drift collisions due to the cleanup.

These savings were determined by comparing existing conditions and boat/drift collision costs with those which would be expected if the debris were removed.

(revised May 80)

Methodology

15. Inquiries were sent to marine repair yards, yacht clubs and marinas to determine such information as the number of recreational vessels damaged by collision with floating debris and repaired in each respective facility, the type of damage, the average repair costs, and the approximate location where the collisions occurred.

16. Shipyards, tugboat companies, the stevedores' union, and other parties were contacted to determine the incidence of commercial vessel/drift collisions. None were reported, although some such accidents are believed to have occurred in the past. There is no substantiation to indicate that there would be significant damages to commercial craft over the project life. Therefore, such a benefit was disregarded.

17. Two major factors will influence the number of boat/drift collisions over the project life. One is the number of boats in the study area; the other is the amount of drift.

18. Since accurate data was not available on recreational boat usage of Boston Harbor, statewide boat registrations were examined. Statewide registrations have been growing at an exponential rate of 5.583 percent per annum between 1966 and 1976. Since the population of the Boston Standard Metropolitan Statistical Area (SMSA) has been increasing at approximately the same rate as Massachusetts as a whole,1/ the growth of statewide registrations is believed to be representative of the present growth of Boston Harbor recreational traffic. This high growth rate is, however, expected to slow down due to lack of space for moorings and crowding.

19. Though the volume of drift may well be increasing, the data available is not sufficient to determine the rate of increase. In the interest of a conservative approach, the analysis assumes that the volume of drift is constant over the project life.

1/ OBERS Projections: Regional Economic Activity in U.S., 1972 - Series E: Population Volumes 4,5, U.S. Water Resources Council, 1974.

(revised May 80)

Benefits

20. The navigational benefits described in this section are those expected to accrue to boat owners over the project life in the form of a reduction in boat/drift collisions and resultant damages. The following are the major inputs and assumptions:

- 1976 damages due to boat/drift collisions in Boston Harbor are estimated to have totalled 280,120.
- By 1980, traffic and damages will have increased 5.5 percent (compounded) annually to $347,000.
- Traffic is predicted to increase at the following compounded rates:

1980-1990	-	5.0%
1990-2000	-	4.0%
2000-2010	-	3.0%
2010-2020	-	2.0%
2020-2030	-	1.0%
2030-2035	-	0.0%

- The removal of floating debris and debris sources within the study area is expected to be 90% effective.

21. Accordingly, the present value of the annual damages which would be sustained if this project were not carried out, would equal $9,578,300. The method of calculation is described in Apendix 2.

22. This is equal to an annualized benefit of $705,000.

Property Enhancement Benefits

23. Property enhancement benefits result from a reduction in the cost of future development and from the removal of an unsightly barrier between residential areas and the harbor. These benefits were determined by comparing existing conditions and property values with those expected with debris removal and disposal.

24. The benefits from the reduction in the cost of future development are described first below, and the benefits due to the removal of a barrier between residential areas and the harbor are second.

Methodology — Reduction in Cost of Future Development

25. The reduction in the cost of future development is the future cost of removal and disposal of debris sources where such removal is necessary for redevelopment. Where there are no specific plans for redevelopment, it is assumed that redevelopment will occur within 20 years of debris removal, or in 10 years on the average. Where there are plans for redevelopment, a delay period to redevelopment is estimated based on the status of the plan.

26. Not all sites will be developed for a use which will require the removal of piers. Therefore, future land uses are considered individually as shown in Table F-3.

TABLE F-3

Type of Debris Removal Required for Redevelopment

Land Use	Dilapidated Piers and Piles of Debris	Sunken Vessels
Residential		
w/marina	yes	yes
w/o	yes	no
Commercial	yes	no
Industrial		
waterfront	yes	yes
nonwaterfront	no	no
Parks		
w/marina, swimming beach	yes	yes
w/o	yes	no
Conservation Areas	no	no

27. The expected future use of land was determined from either land use plans or known redevelopment plans for the site.

Benefits

28. The present value of the property value enhancement due to the reduction in expected development costs, for each affected community, are given in Table F-4.

TABLE F-4
BENEFIT FROM REDUCTION IN COST OF FUTURE DEVELOPMENT
(Present Worth Values)[1]

	Residential	Recreation[2]	Industrial[3]	Commercial	Total
Hull	$ 53,924	163,820	-	-	217,744
Hingham	24,905	775	490,942	4,084	520,702
Weymouth	63,781	470	2.800	2,908	69,959
Braintree	-	-	265	-	265
Quincy	110,228	-	166,322	8,631	285,181
Boston	1,301,689	1,677,128	1,436,642	40,422	4,455,881
Cambridge	-	-	3,179	-	3,179
Somerville	-	-	9,755	-	9,755
Everett	-	-	165,403	-	165,403
Chelsea	3,468	-	290,095	-	293,563
Revere	-	-	13,373	-	13,373
Winthrop	41,572	583	-	17,727	59,882
Total:	1,599,567	1,842,776	2,578,776	73,772	6,094,891

1. 7-1/8% discount rate.
2. Includes Public Open Space
3. Includes Industrial Waterfront Uses and Marinas

29. The total annualized benefit equals $448,600.

Methodology—Enhancement of Existing Residential Property

30. The removal of debris sources, particularly dilapidated piers and loose piles of on shore debris, will also remove a major eyesore from residential neighborhoods and increase confidence in their future, which are both important factors in establishing property values.

31. There are no studies which directly relate to the removal of harborside debris, such as covered by this study, and nearby property values. A report 1/ was published in 1975, however, based on a study of property value increases after water quality improvements had been made. The study determined property value increases in relation to the distance of the property from the water and, using a detailed survey of people in the affected areas, established their criteria for valuing different water quality improvements. The results of this survey are shown in Table F-5.

TABLE F-5

Residents' Weighting of Aspects of Water Quality

		%
Wildlife Support Capacity		43
Aesthetics		
Absence of Industrial Wastes	10	
Clearness	7	
Absence of Odor	5	
Absence of Debris and Obstructions	5	
Absence of Algae	4	
All Aesthetics		31
Recreation Opportunity		26
		100

1/ Benefits from Water Pollution Abatement, Property Values. National Commission on Water Quality.

Revised May 1980

32. The study was carried out in a suburban setting and it may be surmised that debris is not so obtrusive as in Boston. In addition, city dwellers cannot reasonably expect to create significant wildlife support capacity as a result of water quality improvements in the inner harbor. They are, therefore, likely to give additional weight to debris removal in the city of Boston. The study further indicates that greater value is given to improvements to the water resources in a traditional maritime community than in rural areas. The weighting has, therefore, been increased to 10 percent.

33. Empirical formulae developed in the above study relate increases in property values to increases in water quality and distance of the property from the water. These formulae are reported here in Appendix 2, Part B. Using them, it is possible to determine the approximate effect a reasonably complete removal of debris will have on residential property values.

34. Only in East Boston, does a significant amount of residential property abut the inner harbor waterfront. There are only two concentrations of debris sources in the outer harbor, and one of these, Hingham Industrial Center, is surrounded by industrial land uses. The other in Town River Bay in Quincy, though visible from some residential developments but not particularly obtrusive, is in an area zoned for industrial use. No enhancement to residential property values outside of East Boston has been assumed.

35. In East Boston, the removal of piers will undoubtedly have a major beneficial effect, which could in turn be reflected in increased property taxes.

36. The value of residential property by census tract in East Boston, as of 1972, was taken from a Boston Redevelopment Authority memorandum.1/ The residential area of each tract within different distances from the bulkhead lines, was also determined.

Benefits

37. The present value of this increase in property value equals $4,753,000. See Appendix 2, Part B, Table B-9. Based on this, the annual benefit from the enhancement of existing residential property in East Boston is $349,800.

1/ Tables showing Boston's housing stock and values by census tract, R. Goetze and E. Blaine, B.R.A. April 27, 1976.

38. An alternative approach to forecasting the enhancement of property values attributable to this project is to examine the past effects of large scale public investment. As indicated in a study described in Appendix 2, Part B, the total value of residential property surrounding urban renewal districts increased by $1.35 for every dollar of government expenditure over and above the average citywide increase in property values. These increased property values will, in turn, generate $1.28 in additional taxes to the city per dollar spent. However, because of the qualitative differences between these projects and the one under study, and our intent to be conservative in forecasting benefits, we have used the $349,800 annualized benefit.

Total Property Enhancement Benefits

39. The total property enhancement benefits, from both the reduction in future development costs and the removal of an unsightly barrier between residential areas and the harbor, are shown in Table F-6.

Employment Benefits

40. In labor market areas which have been designated as redevelopment areas, as is Boston, Massachusetts, the Water Resource Council's Principles and Standards directs that in certain cases the project benefits shall be considered to be increased by the value of the local labor required for project construction. The derivation of the employment benefits is presented in Appendix 2, Part B. Annual employment benefits have been estimated to total $135,400. These benefits were allowable under the guidelines in force while the study was in progress. Under current regulations Boston no longer qualifies for employment benefits.

Decreased Maintenance Costs

41. The Commonwealth of Massachusetts spends approximately $50,000 annually to remove drift from Boston Harbor. If the project is implemented, debris will be reduced by 90%, thus reducing this cost by 90%. A benefit of .9(50,000)=$45,000 is therefore taken.

TABLE F-6

Total Property Enhancement Benefits

		Annual Benefits
Reduction in Cost of Future Development	$	448,600
Enhancement of Existing Residential Property		349,800
TOTAL	$	798,400

Summary of Benefits

42. Navigational and property enhancement benefits are summarized in Table F-7.

TABLE F-7

Summary of Total Average Annual Benefits

Navigational	$	705,000
Property Enhancement		798,400
Reduced Maintenance Cost		45,000
TOTAL BENEFITS	$	1,548,400

Justification

43. The estimated average annual costs and benefits and the ratio of benefits to costs, which are shown in Table F-8, indicate that the removal, collection, and disposal of debris from Boston Harbor is economically justified.

TABLE F-8

Summary of Economic Analysis

Total Average Annual Costs	$	$1,447,700
Total Average Annual Benefits *		1,548,400
Benefit-Cost Ratio		1.07

*Less Employment Benefits

SECTION G

DIVISION OF PLAN RESPONSIBILITIES

DIVISION OF PLAN RESPONSIBILITIES

TABLE OF CONTENTS

LIST OF TABLES

SECTION G

DIVISION OF PLAN RESPONSIBILITIES

1. This section presents information regarding the various responsibilities of federal and non-federal interests with respect to the selected plan. The discussion includes a summary of overall federal and non-federal non-monetary responsibility.

COST APPORTIONMENT

2. The U.S. Congress has stated in Section 202, P.L. 94-587 (the Water Resources Development Act of 1976) that drift and debris on or in the waters and adjacent land areas of publicly maintained commercial boat harbors threaten navigational safety, public health, recreation, and the harbor front environment. Significantly Section 202, (c) of the Act provides cost sharing and cost recovery requirements for federal and non-federal interests. The federal share shall be two-thirds of the cost of the project and the remaining one-third is assigned to the non-federal interests, (state, municipality, or other political subdivision) in which the project is located, when there is no identified owner of the source of the drift or debris. When an owner can be identified, the Corps can remove the drift or debris but the non-federal interests must recover the cost of removal from the identified owner. The repair of partly dilapidated structures and the disposal of unwanted wood material which would be generated from this repair is also a local cost item. Partially dilapdiated structures where the damaged sections are in use or are necessary for the continued use of the structure as a whole are included in this category. Any costs associated with the collection and removal of drift and debris from federally owned lands shall be borne by the federal government.

3. Table G-1 presents a breakdown of the federal and non-federal apportionment of the costs. Owners of water front structures can be identified and thus the costs associated with waterfront structures (primarily timber pile supported wharves and bulkheads) will be by non-federal interests.

TABLE G-1

1/ APPORTIONMENT OF FIRST COSTS OF SELECTED PLAN

DESCRIPTION	TOTAL COST	FEDERAL SHARE	NON FEDERAL SHARE
Work for Removal of Derelict Wooden Vessels, Loose On-Shore Debris, and Floating Drift	3,922,000	2,615,000	1,307,000
Work for Removal of Dilapidated Shore Structures	12,655,000	0	12,655,000
Work for Repair of Partially Dilapidated Shore Structures	2,887,000	0	2,887,000
Total for the Selected Plan:	19,464,000	2,615,000	16,849,000

1/ Cost apportionment is subject to adjustment based on the number of identified owners of drift and debris sources at time of project implementation.

FEDERAL RESPONSIBILITIES

After Congressional authorization and funding, the federal government will undertake to design and implement the selected plan. Such design will include the preparation of all necessary reports, drawings, specifications, and tender documents. Implementation will include the preparation, tender and award of contracts, and supervison of work until completion of the project.

NON-FEDERAL RESPONSIBILITIES

5. Before federal funds can be used for the removal and disposal of drift sources in Boston Harbor, the Commonwealth of Massachusetts must sign a contract with the Corps of Engineers agreeing to the following items of local cooperation:

(1) Provide, without cost to the United States, all lands, easements and rights-of-way required for construction and future maintenance of the project.

(2) Hold and save the United States free from damages due to the construction or maintenance of the project, except those damages which are attributable to the fault or negligence of the Government or its contractor; and hold and save the United States free from any damages which may result from the Commonwealth of Massachusetts' performance, or failure to perform, any of its required responsibilities for the project.

(3) Enact and enforce legislation prior to completion of the project to prevent the creation of future sources of drift and debris. (Annual cost of an inspection has been estimated at $15,000.)

(4) Provide the transfer and disposal sites as proposed including suitable access thereto, or in the alternative provide other sites should the planned sites become unavailable for any reason prior to construction of the project.

(5) In accordance with Section 202, Public Law 94-587, (90 Stat. 2917), 33 U.S.C.A. 426 m:

(a) Contribute a cash payment of 1/3 of the first cost for removal of drift and debris which cannot be attributed to an identifiable owner, a sum presently estimated at $1,307,000.

(b) Contribute a cash payment of 100% of the first cost for removal of drift or debris which is attributable to an identifiable owner, a sum presently estimated at $12,655,000.

(c) Pay its required contributions in a lump sum prior to commencement of project construction or in installments prior to commencement of pertinent work items, in accordance with construction schedules as required by the Chief of Engineers. The final apportionment of cost will be made after actual costs and values have been determined.

(6) Make necessary repairs to deteriorated waterfront structures in use which are potential sources of drift, the cost of which is presently estimated at $2,887,000. The repairs will be performed simultaneously with the work performed by the Federal Government on the project. The material removed in connection with the repairs may be disposed of at no cost to the Federal Government in the facilities provided to the Federal Government for the project.

(7) Comply with the requirements of non-Federal cooperation as specified in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646.

BOSTON HARBOR, MASSACHUSETTS

FEASIBILITY REPORT

FOR DEBRIS REMOVAL

Technical Report

PART A - DEVELOPMENT OF COST ESTIMATES

PART B - DEVELOPMENT OF BENEFIT ESTIMATES

APPENDIX 2

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

DECEMBER 1979
(REVISED MAY 1980)

PART A

DEVELOPMENT OF COST ESTIMATES

ADDENDUM - PART A

DEVELOPMENT OF COST ESTIMATES

Costs of each project feature (i.e., Collection, Removal, Disposal and Repair) have been revised based on an analysis of the following impacts:

(1) Updating work tasks to reflect December 1979 prices levels.

(2) Contengency allowance of 20 percent.

(3) Additional costs for the removal and disposal of 4,500 tons of non-floatable materials.

Rev.
May 1980

DEVELOPMENT OF COST ESTIMATES

TABLE OF CONTENTS

TABLE OF CONTENTS - Continued

LIST OF TABLES

LIST OF TABLES - Continued

DEVELOPMENT OF COST ESTIMATES

1. Cost estimates were developed for removal, collection and disposal of as well as for the repair of partially dilapidated structures in use. Removal includes the costs of removal and transportation to a designated staging area of structures, wrecks and onshore debris. Collection includes the costs of collection and transportation to the staging area of drift material. Disposal includes the cost of unloading, processing, and reloading this material at the staging area and of transporting, dumping and burying it at the landfill site. Repair covers the replacement or reconstruction of damaged sections of structures which are in use or necessary for the continued use of the remaining portions of the structure.

Removal

2. The proposed plan of removal is primarily by water not excluding land removal, should a particular location lend itself best to land removal. Four different types of debris sources have been identified, each requiring a somewhat different removal procedure. To this end, four teams or units are proposed, varying in size, labor force and type of equipment, designed to perform a specific removal operation. These four units are as follows:

Unit One	-	Heavy Waterfront Structures
Unit Two	-	Light Waterfront Structures
Unit Three	-	Wrecked Vessels
Unit Four	-	Loose Onshore debris

3. The following tables outline each unit and its total daily operating costs and production rates followed by a unit cost for material particular to that unit.

Unit One - Heavy Weight Waterfront Structures

TABLE A-1

DAILY COSTS UNIT ONE

Equipment & Supplies		Cost/Day
Steel deck carrier barges or shallow draft barges (2)		$ 200.00
Backhoe Clamshell w/Steel Barge		440.00
Bulldozer (1)		125.00
250 H.P. Tug Boat		250.00
Small launch (1)		50.00
4" Pump (1)		40.00
Pile cutters (2)		75.00
Wrecking Balls (2)		20.00
Pulling head and clamp (1)		50.00
Compressor (1)		15.00
Chain saws (3)		60.00
Paving Breakers (2)		22.00
Miscellaneous tools, materials & supplies		100.00
	Sub-Total	$1,447.00
Labor		**Cost/Day**
Tugboat Crew (3 men)		$ 294.00
Launch Operator		79.00
Backhoe Clamshell Operator (1)		117.00
Shovel Dozer Operator		115.00
Oiler (1) Crane Only		92.00
Oiler (1)		86.00
Dock Foreman (1)		123.00
Dock Workers (4)		464.00
Diver (1)		145.00
Diver's Helper (1)		105.00
	Sub-Total	$1,620.00
	Total	$3,067.00
	Overhead 12%	368.00
	Grand Total (Piles Cut Only)	$3,435.00
Equipment & Supplies		
Same	Sub-Total	$1,447.00
Labor		
Exclude Diver & Diver's Helper	Sub-Total	$1,370.00
	Total	$2,817.00
	Overhead 12%	338.00
	Grand Total (for Piles Pulled and Superstructures Removed)	$3,155.00

Production Rates - Unit One

4. Unit One will be responsible for removing two types of heavy structures; those fully dilapidated requiring complete removal and those only partially dilapidated requiring removal of selective portions. The size of labor force, type of equipment necessary and anticipated production rates are arrived at through analysis of past projects, similar in scope and contact, with contractors experienced in this type of work and familiar with the project area.

5. Production rates for the removal of certain portions of partially dilapidated structures are achieved by decreasing the production rates of fully dilapidated structures removed by a factor of approximately 35%. Though both operations are similar, the additional time required for selective removal of materials, being careful not to damage the structure to remain, must be taken into account. This decreased production is reflected in the increased unit costs for partially dilapidated structures.

TABLE A-2

PRODUCTION RATES - UNIT ONE

Dilapidated Structures	Production Rate
Superstructure	800 C.F./Day
Piles pulled	40 piles/day
Piles cut	60 piles/day
Partially Dilapidated Structures	**Production Rate**
Superstructure	590 C.F./Day
Piles pulled	30 piles/day
Piles cut	40 piles/day

Unit Costs - Unit One

6. All unit costs are in terms of cost per cubic foot. Piles pulled are assumed to have an average length of 50 ft. and piles cut are assumed to have an average length of 10 ft. This was the approximate average length of piles checked during the inventory. One linear foot of pile is assumed to approximate one cubic foot.

TABLE A-3

UNIT COSTS - UNIT ONE

Dilapidated Structures	Unit Cost
Superstructure	$3.94/C.F.
Piles pulled	$1.58/C.F.
Piles cut	$5.72/C.F.
Partially Dilapidated Structures	**Unit Cost**
Superstructures	$5.35/C.F.
Piles pulled	$2.10/C.F.
Piles cut	$8.59/C.F.

Unit Two - Light Weight Waterfront Structures

TABLE A-4

DAILY COSTS - UNIT TWO

Equipment & Supplies		Cost/Day
Steel Deck Carrier Barges or Shallow Draft Barge (1)		$100.00
Tow boat (1)		150.00
Chain saws (2)		40.00
Misc Tools, Supplies & Mat'l		50.00
	Sub-Total	340.00
Labor		**Cost/Day**
Foreman		$123.00
Dock Workers (2)		232.00
Tow Boat Operator		79.00
	Sub-Total	$434.00
	Total	774.00
	Overhead 12%	93.00
	Grand Total	$867.00

Production Rates - Unit Two

7. Twenty-nine locations are identified as being either dilapidated or partially dilapidated and of light construction. Though five of the locations are substantially large (Nos. 45, 251, 269, 461 and 506), the remaining twenty-four average 150 cubic feet of material per location. Most such structures do not have piles. Where piles are included, Unit 1 rates apply.

8. It is anticipated that Unit Two would be able to remove two of these smaller locations, or approximately 300 cubic feet per day. To account for the time required to travel from location to location and for hauling the debris, this figure has been reduced by a factor of 20%, or to 250 C.F./day.

9. As in Unit One, the production rates for material removed from partially dilapidated structures have been reduced by 35% due to the slower and more careful process of working around a structure that is to be retained.

TABLE A-5

PRODUCTION RATES - UNIT TWO

Dilapidated Structure	Production Rate
Superstructure (light)	250 C.F./Day
Partially Dilapidated Structures	**Production Rate**
Superstructures (light)	185 C.F./Day

TABLE A-6

UNIT COSTS - UNIT TWO

Dilapidated Structures	Unit Cost
Superstructure	$3.47/C.F.
Partially Dilapidated Structures	**Unit Cost**
Superstructure	$4.69/C.F.

Unit Three - Derelict (Wrecked) Vessels

TABLE A-7

DAILY COSTS - UNIT THREE

Equipment & Supplies		Cost/Day
Steel deck carrier barges or shallow draft barges (2)		$ 200.00
Backhoe clamshell w/steel barge		440.00
Shovel Dozer (1)		125.00
250 H.P. Tugboat		250.00
Small launch (1)		50.00
Wrecking ball (2)		20.00
Chain saws (2)		40.00
Log boom		30.00
Miscellaneous tools, materials & supplies		100.00
	Sub-Total	$1,255.00
Labor		**Cost/Day**
Tugboat Crew		$ 294.00
Backhoe Clamshell Operator (1)		117.00
Oiler (1)		92.00
Dock Foreman (1)		123.00
Dock Workers (4)		464.00
Diver (1)		145.00
Diver's Helper (1)		105.00
Shovel Dozer Operator		115.00
Launch Operator		79.00
	Sub-Total	$1,534.00
	Total	$2,789.00
	Overhead 12%	335.00
	Grand Total	$3,124.00

Production Rates - Unit Three

10. There are 50 derelict vessels of wood construction in the study area with known quantities totaling 271,500 C.F. Though the quantity of material varies considerably from vessel to vessel, an average of 5,420 C.F. can be established.

11. It is estimated that Unit Three is capable of removing the average vessel in six days' time, including setting up and hauling the material which yields approximately 900 C.F. of material removed per day.

TABLE A-8

PRODUCTION RATES - UNIT THREE

	Production Rate
Derelict (Wrecked) Vessels of Wood Construction	900 C.F./Day

TABLE A-9

UNIT COSTS - UNIT THREE

	Unit Cost
Derelict (Wrecked) Vessels of Wood Construction	$3.47/C.F.

Unit Four - Loose Onshore Debris

TABLE A-10

DAILY COSTS - UNIT FOUR

Equipment & Supplies	Cost/Day
Front end loader (1)	$120.00
Steel deck carrier barges or shallow draft barges (2)	200.00
Tow boat (1)	150.00
Chain saws (2)	40.00
Miscellaneous tools, materials & supplies	100.00
Sub-Total	$610.00

TABLE A-10 (cont.)

DAILY COSTS - UNIT FOUR

Labor		Cost/Day
Loader operator (1)		$115.00
Dock workers (3)		348.00
Foreman (1)		123.00
Tow boat operator		79.00
	Sub-Total	$665.00
	Total	$1,275.00
	Overhead 12%	153.00
	Grand Total	$1,428.00

Production Rate - Unit Four

12. The latest inventory of loose onshore debris indicates there are 168 locations in Boston Harbor totaling over 181,000 cubic feet of material or approximately 1,077 cubic feet per location.

13. Unit Four is designed to be able to cut, load and haul an estimated 960 cubic feet of material per day. This figure must be reduced by 20%, however, to allow time to locate, set up, haul and move from site to site.

TABLE A-11

PRODUCTION RATE - UNIT FOUR

	Production Rate
Loose Onshore Debris	770 C.F./Day

Unit Costs - Unit Four

14. To allow for final cleanup of all shorefront areas at the end of the project, the unit costs have been increased by 25% to compensate for the additional time.

TABLE A-12

UNIT COSTS - UNIT FOUR

	Unit Cost
Loose Onshore Debris	$2.27/C.F.

Collection - Unit Five

15. A fifth type of unit will be required to collect drift material. The costs for this unit are outlined below.

TABLE A-13

DAILY COST - UNIT FIVE

Equipment & Supplies		Cost/Day
Shallow draft barge or float (1)		$ 100.00
Tow boat (1)		150.00
Chain saws (2)		40.00
Hoist - 2 ton (1)		20.00
Miscellaneous tools, materials & supplies		100.00
	Sub-Total	$ 410.00
Labor		**Cost/Day**
Dock workers (3)		$ 348.00
Dock foreman (1)		123.00
Hoist operator		117.00
Tow boat operator		79.00
	Sub-Total	$ 667.00
	Total	1,077.00
	Overhead 12%	129.00
	Grand Total	$1,206.00

Production Rates - Unit Five

16. It is estimated that, on an average day, approximately 1350 C.F. of drift exists in the study area with the largest concentration being within the inner harbor. This figure substantially increases following a storm or "moon tide" when exceptionally high tides are experienced, transferring much of the loose onshore debris into the harbor waters.

17. In order to make one complete sweep of the harbor and remove all floating debris sighted, it is estimated to take 15 days. This yields an average production rate of drift removal of 90 C.F./day.

18. It is proposed that Unit Five operate during the entire cleanup project as concentrations of drift are not expected to decline until project completion.

TABLE A-14

PRODUCTION RATE - UNIT FIVE

	Production Rate
Drift	90 C.F./Day

TABLE A-15

UNIT COSTS - UNIT FIVE

	Unit Cost
Drift	$13.40/C.F.

Summary Of Removal And Collection Costs

19. A complete list of labor and equipment requirements implicit in the total removal and collection cost is given in Table A-16. Table A-17 provides a summary of the removal and collection costs.

TABLE A-16

REMOVAL AND COLLECTION

Labor - Total List

	Wage +	O.H. (37%)	Total Wage/Hr.	Cost/Day
Crane or Backhoe Opr.	$10.61	$3.93	$14.54	$117.00
Dozer or Loader Opr.	10.49	3.88	14.37	115.00
Oiler	8.32	3.08	11.40	92.00
Oiler	7.84	2.90	10.74	86.00
Dock Foreman	11.15	4.13	15.28	123.00
Dock Workers	10.50	3.89	14.39	116.00
250 H.P. Tug Crew	9.00	3.24	12.24	(98.00) each
(3) man crew			(98.x 3)	= 294.00
Diver	13.25	4.47	18.02	145.00
Diver's Helper	9.65	3.47	13.12	105.00
Boat Operator (Launch or Tow Boat)	7.25	2.61	9.86	79.00

Equipment - Total List

250 H.P. Tugboat	$250/day	
Tow Boat	150/day	
Small Launch	50/day	
Backhoe/Clamshell	380/day	
Shovel Dozer or D-8	125/day	
$30/hr with operator		
30x8 = $240		
- 115 operator		
$125		
Carrier Barge	100/day	
Shallow Draft Barge	100/day	
Backhoe w/carrier Barge $380+$60 =	440/day	
4" Pumps	40/day	
Pile Cutters	75/day	
Wrecking Ball	10/day	
Pulling Head/Clamp	50/day	
Compressor (3-50-ft. hoses)	15/day	(by month)
Chain Saws	20/day	
Paving Breakers (2)	11/day	
Miscellaneous	100/day	
Front End Loader	120/day	
Hoist	20/day	

TABLE A-17

REMOVAL AND COLLECTION SUMMARY TABLE FOR ESTIMATING PURPOSES

	Type of Material Removed	Daily Cost of Operations($)	Production Rate (CF/Day)	Total Quantity to Remove(CF/Tons)	Estimated Unit Days	Material Unit Costs to Remove ($/CF)	Total Cost($)
UNIT ONE	Dilapidated Structures						
	1. Superstructure	3,155.00	800	811,100/4200	1014	3.94	3,195,700
	2. Piles Pulled	3,155.00	2,000	1,504,100	752	1.58	2,376,500
	3. Piles Cut	3,435.00	600	32,700	55	5.72	187,000
	Partially Dilapidated Structures						
	1. Superstructure	3,155.00	590	111,800	189	5.35	598,100
	2. Piles Pulled	3,155.00	1,500	165,700	110	2.10	348,000
	3. Piles Cut	3,435.00	400	5,600	14	8.59	48,100
UNIT TWO	Dilapidated Structures (Light)	867.00	250	31,000	124	3.47	107,600
	Partially Dilapidated Structures (Light)	867.00	185	17,000	92	4.69	79,700
UNIT THREE	Derelict Vessels	3,124.00	900	271,500/300	302	3.47	942,100
UNIT FOUR	Loose Onshore Debris	1,428.00	770	181,000	302	2.27[1]	411,375
UNIT FIVE	Drift	1,206.00	90	67,500[2]	750[2]	13.40	904,500
			TOTAL QUANTITY	3,199,300		TOTAL COST	9,198,525[3] (10,563,600)[4]

1/ Unit costs have been increased by 25% to compensate for final cleanup of shore areas at the end of the project.
2/ Approximate for Estimating Purposes Only
3/ Excludes Contingency, Engineering & Design, Administration & Supervision

4/Total cost has been increased by 14 percent to reflect December 1979 price levels and $77,300 added for removal of 4500 tons of non-floatable material.

Disposal

20. Disposal includes the cost of unloading, processing and reloading the collected material at the staging area as well as hauling, dumping and burying it at the landfill site.

21. The following outlines the daily operating costs, production rates and unit costs for this process.

Unloading

22. It is assumed that unloading the debris from the carrier barges onto the staging site will be done using a clamshell/backhoe. The daily crew cost is given in Table A-18. The entire barge cost has been assigned to the removal operation.

TABLE A-18

DAILY COSTS - UNLOADING

Equipment		Cost/Day
1. Clamshell/Backhoe		$380.00
	Sub-Total	$380.00
Labor		**Cost/Day**
1. Clamshell/Backhoe Operator		$117.00
2. Clamshell/Backhoe Oiler		92.00
	Sub-Total	$209.00
	Total	589.00
	Overhead 12%	70.00
	Grand Total	$659.00

Production Rates - Unloading

23. The production rate of the unloading area is expected to equal the amount of material removed/collected by Units One through Five, excluding work effort on partially dilapidated structures to be done by others. This rate could be as high as 3100 cf/day in the early stage of the project. However, production rates per unit and debris volumes per debris source vary. As a result, one or more removal plants (units) will complete work tasks before others. Accordingly, a weighted average production rate of 2652 cf/day over the life of the project has been used to represent planned removal operations.

24. The implied number of crew-days required is thus equal to 3,199,300 C.F. (total amount of debris) divided by the 2652 C.F./day rate and equal to 1206 crew-days.

Summary Of Costs - Unloading

25. Unloading unit costs are provided in Table A-19 and total costs in Table A-20.

TABLE A-19

UNIT COSTS - UNLOADING

$\frac{\$659.00/\text{day}}{2652\ \text{C.F./day}}$	=	$0.248/C.F.

TABLE A-20

TOTAL COSTS - UNLOADING

TOTAL COST = $659.00/crew-day x 1206 crew-days = $794,754

Processing, Loading, Hauling, Dumping and Burying

26. Sylvester Ray Enterprises, Inc., owner and operator of the Marshfield landfill site, provided cost estimates for this part of the process. The prices quoted were $160/truckload for processing, loading, hauling, dumping and burying from the Boston Navy Yard site, and $150/truckload from the Hingham Industrial Center site.

27. The cost estimates assume the use of 60 C.Y. demolition trucks carrying 35 C.Y. of debris. Thus, required truckloads per day would average 2652 C.F./945 C.F. per truckload, which equals approximately 3 truckloads per crew day.

28. The estimates also assume that 93% of the total amount of material will be shipped from the Boston Navy Yard site and the remaining 7% from the Hingham site. Hence, the required number of truckloads for Boston will be 1121 crew-days x 3 truckloads per crew day equaling 3363 truckloads. The estimates for Hingham are 85 crew-days x 3 truckloads per crew-day equaling 255 truckloads.

29. Total costs are given in Table A-21, unit costs in Table A-22.

TABLE A-21

COSTS OF PROCESSING, LOADING, HAULING, DUMPING, AND BURYING

From Boston:	3363 truckloads x $160/truckload	538,080	
	Overhead @ 12%	64,570	
	Sub-Total		602,650
From Hingham:	255 truckloads x $150/truckload	38,250	
	Overhead @ 12%	4,590	
	Sub-Total		42,846
	TOTAL		645,490

TABLE A-22

UNIT COSTS OF PROCESSING, LOADING, HAULING, DUMPING, AND BURYING

Unit Costs = Total Cost / Production

From Boston:	$602,650/2,975,300 C.F.	$0.203/C.F.
From Hingham:	$42,840/224,000 C.F.	$0.191/C.F.

Total Disposal Costs

30. Total disposal costs include the costs of unloading, processing and loading at the staging site in addition to hauling, dumping and burying at the landfill site. A summary of these costs is provided in Table A-23.

ADDITIONAL COSTS FOR THE REMOVAL AND

DISPOSAL OF NON-FLOATABLE MATERIALS.

31. The removal process will also include an estimated 4500 tons of non-floatable material, (i.e., primarily concrete and asphalt that form some part of certain dilapidated waterfront structures estimated at 4200 tons and 300 tons of ordinary soils found contained within hulls of certain wrecked vessels). Unit One, detailed in Table A-1, has the capability to do this added work. A production rate of 200 tons per day is considered reasonable. The rate was arrived at through analysis of projects similar in scope and contact with contractors experienced in this type of work. Accordingly, Unit One is expected to remove 4500 tons of non-floatable material in about 22 days. (e.g., demolish material, place on adjacent barge and haul to transfer site). Thus, the total cost of the removal process has been estimated at $77,300 or $17. per ton.

32. The disposal process includes the cost of unloading from barges and stockpiling at transfer site in South Boston, reloading on trucks, hauling 30-mile one way trip, dumping and burying it at the landfill site. The plant operation is expected to be similar in scope as described in paragraphs 23-28 of this appendix. The plant's production rate has been estimated at 36 tons per day. The rate was adjusted to account for the use of 12 ton capacity trucks making 3 roundtripss per day. On this basis, the disposal of non-floatable materials would take 125 days and at $160 per truckload per day, cost about $20,000.

33. Accordingly, the total estimated cost of removal and disposal of non-floatable materials based on December 1979 price levels is $97,300.

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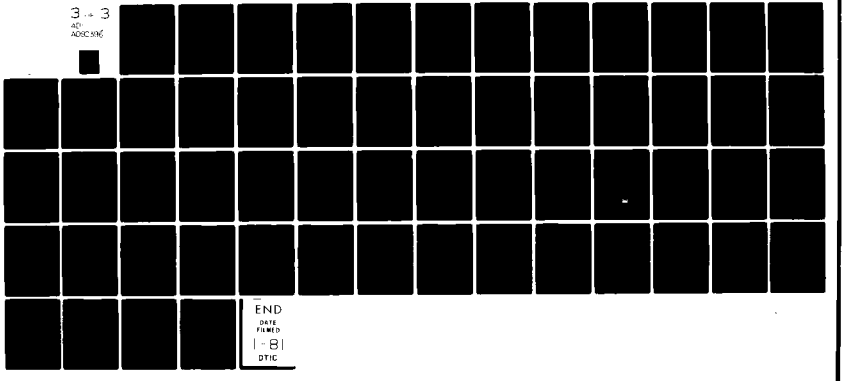

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TABLE A-23

SUMMARY OF DISPOSAL COSTS[1]

	$794,754
Processing, Loading, Hauling, Dumping and Burying	645,490
	$1,440,244(1,661,900)*

Excluding contingencies, supervision, administration, engineering and design, but the figure in parenthesis does include a 14 percent increase to reflect December 1979 price levels and $20,000 for disposal of non-floatable materials.

Repair

34. The repair costs covered the replacement of damaged portions of partially dilapidated structures after their removal and disposal. Each pier was inspected and, where appropropriate, the owner contacted to determine whether the damaged portion was in use or was necessary for the continuing use of the adequate section of the structure. Where the present use of the structure differs from the original use, the replacement cost has been assessed for a construction satisfactory for the present use. For example, where a general merchandise wharf built to handle ocean-going ships is being used for lobster fishing, replacement costs were based on the construction of a fishing wharf. Some bridge fender systems in Reserved and and Fort Point Channels were built to handle large ocean-going vessels which no longer use the channels. The city of Boston is permitted to maintain the drawspans in the Congress and Summer Street bridges over the Fort Point Channel in a closed position. The draws are to be returned to an operable condition within six months after notification from the Commandant, U.S. Coast Guard to take such action. Due to the changed navigation needs of the channel it is assumed that far less extensive fenders are required and the computed repair cost has been halved. The Massachusetts Department of Public Works advises that it is planned to replace the Northern Avenue Bridge. It is, therefore assumed that the fenders for this bridge, which are largely dilapidated, will be replaced as part of the bridge reconstruction and their replacement cost is not assessed against this project.

35. The repair costs have been assessed on the basis of unit costs of construction in 1978 for such items as piles, piling and bulkheads for the structures intended service. The following unit costs were used:

- Complete Section of Pier	- $47.75 sq. ft.
- Piles (Based on 50 ft. Piles)	- $625.00 ea.
- Section of Bulkhead	- $47.75 sq. ft.
- Decking - light duty	- $10.00 sq. ft.
- Decking - heavy duty	- $14.00 sq. ft.
- Waler (12" x 12"	- $10.00 lin. ft.
- Light decking and stringers	- $15.00 sq. ft.

Total Repair Costs

36. The amount of deterioration and replacement, together with costs, are summarized in Table A-24. The repair cost is estimated at $1,722,445 (see Appendix 4, Part A, Inventory Summary Tables) and includes removal and disposal of deteriorated parts. The repair cost has been increased to $2,128,800 to reflect December 1979 price levels.

Summary Of Costs

37. A summary of costs by operation is presented in Table A-25, and by community in Table A-26. 20 percent contingencies and 13 percent for supervision, administration, engineering and design have been included in these costs.

TABLE A-25

SUMMARY OF TOTAL ESTIMATED PROJECT COSTS BY OPERATION

Collection	-	$ 1,398,000
Removal	-	12,926,000
Disposal	-	2,253,000
Repair	-	2,887,000
Total Project Cost	-	19,464,000

TABLE A-24

REPAIRS - SUMMARY TABLE

Community	No. of Struc.	Pier Section Sq. Ft.	No. of Piles	Bulkhead Sq. Ft.	Decking Light Duty Sq. Ft.	Decking Heavy Duty Sq. Ft.	Waler Sq. Ft.	Light Decking & Stringers	Repair Costs
Hull	2				495	900			$ 25,000
Hingham	2		26	300					40,700
Weymouth	1								10,400
Quincy	1		20						20,200
Boston	27	2950	156	17,185	625	9970	860	2205	1,812,200
Chelsea	4	6880					100		454,900
							TOTAL		$2,363,400
									($2,886,600)*

*Reflects December 1979 price levels, a 14% increase and a 20% contingency factor.

TABLE A-26
SUMMARY OF TOTAL ESTIMATED PROJECT COSTS BY COMMUNITY
SELECTED PLAN

COMMUNITY	VOLUME OF DEBRIS CUBIC FEET	VOLUME OF DEBRIS PERCENTAGE OF TOTAL	COSTS (DOLLARS) REMOVAL & DISPOSAL* 2/3 FEDERAL 1/3 NON-FED.	COSTS (DOLLARS) REMOVAL DISPOSAL AND REPAIR** 100% NON-FEDERAL	COSTS (DOLLARS) TOTAL PROJECT
Hull	42,900	1.3	58,700	210,500	269,200
Hingham	295,500	9.2	207,000	979,500	1,186,500
Weymouth	22,700	0.7	67,400	28,300	95,700
Braintree	300	0.0	700	300	1,000
Quincy	89,000	2.8	169,200	260,400	429,600
Boston	2,203,300	68.9	2,018,200	9,183,700	11,201,900
Cambridge	4,300	0.1	1,100	11,900	13,000
Somerville	11,400	0.4	11,800	29,200	41,000
Everett	183,700	5.7	97,900	585,100	683,000
Chelsea	308,600	9.7	484,700	1,242,800	1,727,500
Revere	8,300	0.3	23,900	29,500	53,400
Winthrop	29,300	0.9	23,600	102,600	126,200
TOTALS:	3,199,300	100.00	3,164,200 (3,922,000)	12,663,800 (15,542,000) 1/	15,828,000 (19,464,000) 1/

*Includes Wrecked Vessels; & Loose On-shore Floatable Debris, i.e. sources of drift and debris for which owners can not be identified. (See paragraph 38 of this Appendix).

**Includes dilapidated waterfront Structures and the repair of partially dilapidated waterfront structures in use, i.e. sources of drift and debris for which owners can be identified.

1/ Reflects Revised Cost estimates, May 1980.

38. Wrecked vessels including non-floatable materials confined within their hulls, loose on-shore floatable debris and drift are the only debris sources under study at this time eligible for cost sharing. A breakdown of project costs relating to these three debris sources is as follows:

ITEM	QUANTITY CF - TONS		COST
Loose On-Shore Debris**	181,000		518,844
Wrecked Vessels**	271,500		1,076,906
Drift	67,500		935,550
		*	2,531,300
		14%	354,400
			2,885,700
Non-Floatables	300		6,500
Sub Total			2,892,200
Contingencies		20%	578,500
			3,470,700
E&D and S&A		13%	451,300
	TOTAL		$3,922,000

*(Percent used to update price levels to December 1979)

**(See Appendix 4 inventory summary tables)

PART B

DEVELOPMENT OF BENEFIT ESTIMATES

DEVELOPMENT OF BENEFIT ESTIMATES

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES - continued

LIST OF FIGURES

DEVELOPMENT OF BENEFIT ESTIMATES

1. Benefits considered are navigational, enhancement of property values, and area employment and reduction of State maintenance costs. The navigational benefits result from a reduction in the number of boat/drift collisions. Enhancement of property values results from a reduction in the expected cost of future development and increased values of existing residential property due to the removal of an unsightly barrier between them and the main local scenic attraction, the harbor. The employment benefits which arise from the hiring of unemployed and underemployed workers in the project area are displayed but are not included in the benefit/cost analysis. Under current guidelines which state that an area must have both substantial and persistant unemployment to be considered for these benefits Boston does not qualify.

Navigational Benefits

2. A major difficulty attending navigation within the study area is that of boat/drift collisions. Removal of floating debris and debris sources will result in a reduction in the number of boat/drift collisions and thus a reduction in the amount of damages sustained by boat owners.

Methodology

3. Inquiries regarding damages resulting from boat/drift collisions in Boston Harbor were made to marine repair yacht clubs, marinas, tugboat companies and other sources in the study area. Information sought included the number of recreational and commercial vessels damaged by collision with floating debris and repaired in each respective facility, the type of damage, the average repair cost, and the approximate location where the collisions occurred. Only damages due to boat/drift collisions were considered. Other types of damages were excluded from the survey.

4. The following information was obtained for 1976 and is detailed in Table B-1.

- 55 Establishments were contacted
- 35 Yards reported that they carried out repairs to recreational boats
- 20 Yards reported repairs as a result of 336 boat/drift collisions totalling $210,000
- 7 Yards reported that they did repairs but had done no boat/drift collision repairs

TABLE B-1

BREAKDOWN OF BOAT/DRIFT COLLISION REPAIRS IN 1976

NAME OF REPAIR YARD	LOCATION	Total No. of Boat/ Drift Collision Repairs	Total Cost of Boat/ Drift Collision Repairs	No. of Repairs to Inboards	Cost of Repairs to Inboards	No. of Repairs to Outboards	Cost of Repairs to Outboards	No. of Repairs to Sailboats	Cost of Repairs to Sailboats	No. of Repairs to Unspecified Boats	Cost of Repairs to Unspecified Boats	Comments
Valdemar Bang	East Boston											No detailed data
Belle Isle Sales & Service	Winthrop											No detailed data
Bill's Outboard Motor Service	Hingham											No detailed data
Boston Boat Sales, Inc.	Dorchester	24	13,200	24	13,200							
Boston Harbor Marina	North Quincy											No detailed data
Coast Marina, Inc.	Winthrop	3	1,800			3	1,800					
Gould Boat Shop	Hull											No detailed data
Harbor Marina Service	Boston											No detailed data
Hewitt's Cove Marina Inc.	Hingham	12	2,150	5	1,250	6	600	1	300			
Larry's Marine & Sport's Center	So. Weymouth	10	8,900	17	5,950	10	2,500	3	450			
Marine Engineering Transmission Co.	Devere	2	950	2	550							
Metallan Boats, Inc.	Everett	1	250			1	250	3	1,200			
Multihull Assoc., Inc.	Hingham	4	2,100	1	500	2	600	2	750			
New Town Harbor Marina	Weymouth	14	6,900	10	5,000	3	750					
North Shore Boat Works	Devere	1	150	1	150							
North Weymouth Marina	No. Weymouth	6	1,000	6	1,000							No detailed data
Northeast Fiberglass	Hull											
Yacht Yard Sales		144	49,000	66	29,000	25	6,500	9	2,700			

TABLE B-1 (Continued)

BREAKDOWN OF BOAT/DRIFT COLLISION REPAIRS IN 1976

NAME OF REPAIR YARD	LOCATION	Total No. of Boat/ Drift Collision Repairs	Total Cost of Boat/ Drift Collision Repairs	No. of Repairs to Inboards	Cost of Repairs to Inboards	No. of Repairs to Outboards	Cost of Repairs to Outboards	No. of Repairs to Sailboats	Cost of Repairs to Sailboats	No. of Repairs to Unspecified	Cost of Repairs to Unspecified	Comments
Norwood Marine, Inc.	Dorchester	60	90,000							60	90,000	
Robert N. Payson	Hingham											No detailed data
Quality Fiberglass	Hingham	15	30,000							15	30,000	
Quincy Adams Marine Basin	Quincy	6	3,000							6	3,000	
Rogers Marine Service	Quincy	25	6,250							25	6,250	
Russo's Marine Mart, Inc.	Medford	30	6,000							30	6,000	
Savin Hill Yacht Club	Dorchester	1	350							1	350	
Sea Street Marine	Quincy	25	10,000							25	10,000	
So. Shore Marine Service, Inc.	Hingham	50	14,500	20	7,000	30	7,500					
Viking Marine Service Inc.	Winthrop	4	3,000							4	3,000	
Waveland Marina, Inc.	Hull	20	8,000							20	8,000	
Bert's Boat Yard	No. Weymouth	0	0									
Charles River Marina, Inc.	Cambridge	0	0									
J.P. Inglin Marine, Inc.	Winthrop	0	0									
Hingham Marine Center	Hingham	0	0									
Mass. Marine Service	Quincy	0	0									
Mutton Snyder, Inc.	Chelsea	0	0									
Mr. American Marine Services, Inc.	Boston	0	0									
TOTAL THIS SHEET		236	171,000	20	7,000	30	7,500	0	0	186	156,600	
TOTAL PREVIOUS SHEET		100	39,000	66	29,800	25	6,500	9	2,700	0	0	
GRAND TOTAL		336	210,000	86	36,800	55	14,000	9	2,700	186	156,600	

- 8 Yards reported that they had done boat/drift repairs in 1976 but gave no details

- 2 did not answer, and it is assumed for estimation purposes that one is a repair yard

5. The various sources revealed that 1976 was a typical year in terms of number of boats damaged by collisions with drift. Since data was readily available for that year and damages were determined to be representative of average annual damages, 1976 was taken as a base year.

6. Ship repair yards and boatyards were canvassed, but none reported any repairs to commercial vessels in Boston Harbor in 1976 as a result of collisions with drift. Discussion with the Coast Guard, Boston Pilots, and various private interests uncovered few damages to commercial vessels from boat/drift collisions. Because damage to commercial vessels appear to be insignificant, such damages are taken to be zero.

7. There are two major factors which will influence the number of boat/drift collisions over the project life. One factor is the number of boats in the study area and the other is the amount of drift.

8. The size of the recreational boating fleet in Boston Harbor was estimated at about 7,500 in 1977 as described on page B-19. However, no figures are available by which the rate of growth may be estimated.

9. The National Association of Engine and Boat Manufacturers provided statistics showing the number of boat registrations in Massachusetts for the years 1966-1976. These are exhibited in Table B-2. An exponential curve was fitted to these data using a regression analysis. The annual growth rate was found to be 5.583% with a correlation coefficient of 0.86.

TABLE B-2

RECREATIONAL MOTORBOAT REGISTRATIONS IN MASSACHUSETTS

YEAR	REGISTRATIONS
1966	88,049
1967	94,674
1968	99,630
1969	103,326
1970	109,503
1971	105,119
1972	109,785
1973	131,846
1974	139,695
1975	141,806
1976	156,000

10. Since population projections show the state and the Boston SMSA population to be increasing at a uniform rate during the project life, it may be assumed that the rate of growth in the number of boat registrations will also be uniform.

11. Future growth of the recreational fleet at Boston Harbor can be expected, though not at the same high rates seen in the 1966-76 decade. Evidence that expansion of the fleet is probable are the numerous plans for marina development in the area. New developments have already been created off the Main Ship Channel along the downtown Boston waterfront and at the mouth of the Charles River. Additional developments are in the planning states at Little Mystic Channel, Island End River, Columbia Point, Charlestown Navy Yard, and at the Naval Hospital in Chelsea. Provisions are being made for approximately 500 boats at the Navy Yard, around 250 at Island End River, and another 250 at the MDC marina at the Naval Hospital.

12. Factors which will provide a downward influence on fleet size are State and SMSA population and income. By the year 2000 these two characteristics will continue to grow, but at a decreasing rate. Another downward influence will be the increased costs of boating resulting from higher fuel prices and higher costs for slips and moorings. As the demand for berths grows, their lack of availability could cause an increase in the transiet fleet launched from ramps. Eventually the number of boats using the harbor would reach a maximum due to overcrowding conditions. The fact that increased congestion could also cause conflicts with commercial traffic is another reason why the growth of the recreational fleet will be limited. Based on the information above, the exponential annual growth rates of the fleet vulnerable to boat/drift collisions are projected as follows:

1976 - 1980 - 5.5%
1980 - 1990 - 5.0%
1990 - 2000 - 4.0%
2000 - 2010 - 3.0%
2010 - 2020 - 2.0%
2020 - 2030 - 1.0%
2030 - 2035 - 0.0%

13. This will produce an equivalent fleet at risk of about 38,000 in the year 2030. The equivalent fleet at risk is not just a measure of all permanently moored boats along with all transiets in the Boston Harbor area. It is more a reflection of the fleet's vulnerability to collisions than it is an actual count of boats. It takes into consideration the fact that transients are in operation a high percentage of the time they are in harbor waters and are thus vulnerable to collisions a high proportion of the time. This constrasts with moored boats which are in operation for a relatively low proportion of the time spent in the water. Also taken into consideration is the fact that leisure time is likely to increase in the future and therefore boat outings per vessel may increase consequently increasing the risk of collisions.

14. As mentioned in para. 4 page B-4, eight of the respondents to the information inquiries reported repairs to boats damaged in boat/drift collisions, but did not have any information regarding the cost of repairs. Two did not answer, and it is assumed that one is an operational repair yard making the total nine. The average cost of boat/drift collision repairs made by each of the other 27 repair yards in 1976 was $7,781. Assigning the mean cost of repairs to each of the nine repair yards, resulted in a 1976 total cost of repairs due to boat/drift collisions of $280,120.

15. The projected benefit does not reflect, however, an increase in volume of drift ~~volume~~. The amount of loose on-shore debris that becomes drift is determined by meteorological factors and may be assumed to be constant over the project life. The volume of drift, therefore, is directly proportional to the volume of loose on-shore debris.

16. Several waterfront sites and areas around the harbor have been redeveloped. This involved the removal of most of the debris around the sites. Despite the fact that areas like Lewis Wharf in the North End and Shore Plaza in East Boston were cleaned up, surveys show that the amount of loose on-shore debris increased from 75,000 cubic feet in 1971 to 191,000 cubic feet in 1976. Reasons for the large increase include waterfront construction, illegal dumping, and the formation of additional debris sources.

17. The volume of drift that will be present during the project lifetime will be influenced by several factors. Population growth and additional waterfront activity will have an expanisionary effect on the amount of debris that will exist. The influences that were present during the 1971-1976 time period (construction, illegal dumping, additional debris sources) will continue to pose problems. Some sources estimate that drift can be expected to increase by one-half to one percent annually during the project lifetime. The drift entrance rate for the 1971-76 period, however, was much higher than this. Further complicating the situation is the fact that a significant amount of waterfront development can be expected to occur over the next twenty-five years. This development will entail removing many of the debris sources and thus decreasing the potential for drift. It appears that counteracting forces will be in effect in the future. Because it is assumed that these forces will balance out, the approach taken has been to consider the volume of drift to be constant over the project lifetime.

18. The following losses due to boat/drift collisions could not be quantified and are not included in the analysis, though they may be significant.

- Repairs carried out at home or at onshore marinas
- Personal injury sustained in collisions
- Loss of use of boats while being repaired

Benefit

19. A formula was developed to calculate the present worth of these benefits taking the rate of increase in boat/drift collisions into account. In this formula, an effective rate of interest is used, such that the project discount rate is compensated by the rate of increase in collisions. The project cannot be completely effective in removing floating debris since some debris will continue to be introduced by illegal dumping from ship and shore. It is assumed that the collisions are proportional to the amount of debris in the harbor and that the amount will be reduced by 90%. Thus, the navigational benefits will be:

$$0.9A \frac{(1+r)^n - 1}{(1+r)^n r}$$

where $(1+r) = \frac{(1+i)}{(1+b)}$

shere
- A = Initial Annual Boat Damage
- i = Project Discount Rate
- b = Rate of Increase of Boat/Drift Collisions
- n = Number of Years

20. The value of the navigational benefits calculated are presented in Table B-3 assuming a project implementation date of 1985.

21. Using the project capital recovery factor of 0.07360, the annualized benefits will be $705,000.

Property Enhancement Benefit

22. The removal of dilapidated piers and other debris sources will have a significant effect on property values. It will reduce the cost of site redevelopment due to the prior removal of the piers, making the site more valuable to a prospective developer. It will increase the value of surrounding residential property in some areas due to the removal of an unsightly and threatening barrier between them and the main local scenic attraction, the harbor. It will help to generate confidence in the future of surrounding communities required to generate private investment in its renewal and rehabilitation. Experience elsewhere in Boston, as well as the United States and abroad, indicated that once such confidence has been established, property values will rise rapidly.

23. The assessment of property enhancement has been divided between the sites of debris removal and surrounding residential

TABLE B-3

NAVIGATIONAL BENEFITS

Years	Projected Rate Growth	Initial Projected Annual Repair Cost without Project[1]	P.V. Navigational Benefits at Start of Period[2]	1985 P.V. of Navigational Benefits[3]
1976-1980	5.5	$ 280,100	--	--
1980-1985	5.0	347,000	--	--
1985-1990	5.0	442,900	1,877,500	1,877,500
1990-2000	4.0	565,300	4,338,800	3,075,500
2000-2010	3.0	836,800	6,107,000	2,175,000
3010-2020	2.0	1,124,600	7,806,200	1,396,900
2020-2030	1.0	1,370,900	9,053,300	814,000
2030-2035	0	1,440,800	5,299,000	239,400
		Total Present Value of Navigational Benefits		$9,578,300

1. Based on increased number of Boat/Drift Collisons.
2. Calculated using formula described in paragraph 19.
3. Discounted at 7-1/8%.

property, with a separate methodology used for each calculation. The benefit to the site of the debris is calculated as a reduction in the cost of redevelopment, while the benefit to surrounding residential property is calculated on the basis of the increase to be expected in the value of existing houses and buildings. To assure that no double counting of benefits occurs, if a debris site is also residential, only the benefit due to increased property value is taken.

Benefit From Reduction in Cost of Future Redevelopment

24. Most of the dilapidated piers and other debris sources lie on prime waterfront land, which will be at some later date redeveloped for some waterfront, industrial, commercial, residential or recreational use. In most cases redevelopment will require removal of the debris, whether to gain access, to remove an eyesore, or to increase the site area by filling. The developer will be spared the cost of debris removal by the project, and it is assumed that the value of the site to him will be increased by this saving in costs. In some cases the removal of surrounding debris sources will also increase the value of the site, for instance, by removing an unattractive outlook and increasing the rentability of apartments which are being built. The removal of the debris, in other cases, might decrease the cost of redevelopment sufficiently to make an otherwise uneconomical project viable, and lead to its execution which would not otherwise have occurred. There will be a benefit to the developer, and one to the community. Although the tax base will increase, the community will have to provide compensating additional services in schooling, police, fire, sewage, lighting, etc.

25. There are no reasonable yardsticks by which to measure the effect of debris removal on surrounding sites, the level of project viability, or the benefits versus costs of the tax flow generated and services demanded by a new facility. Therefore, the reduction in cost of future redevelopment has only been used to estimate the increase in value of the sites from which debris is removed.

Methodology

26. There are definite or preliminary plans for redevelopment of some of the sites of debris sources, but for many sites plans have not yet been formulated. Because waterfront sites are becoming increasingly attractive and because of increasing pressures for land space, it is projected that these sites will be redeveloped over the twenty years following project completion. It is thought that an average redevelopment will occur ten years after the project implementation date of 1985. Where plans for redevelopment already exist a delay period to redevelopment is estimated based on the status of the plan.

27. Not all sites will be redeveloped for a use which will require removal of the piers. Therefore, future land uses are considered individually as follows.

Residential - Removal of dilapidated piers and piles of debris is considered to be essential for residential redevelopment. The removal of sunken vessels is not considered essential unless a marina is to be included in the plan.

Commercial - It is assumed that commercial redevelopment will come as a part of residential redevelopment and will require the removal of dilapidated piers and piles of debris excluding sunken vessels.

Parks and Other Recreational Facilities - It is assumed that dilapidated piers and piles of debris would have to be removed as part of the development of a park or recreational area. Sunken vessels would have to be removed if a marina or swimming beach is to be provided, but not otherwise.

Conservation Areas - It is assumed that sources of debris consisting of piers, vessels and piles of debris would not interfere with conservation areas , therefore, their removal would not bring a significant benefit to them.

Industrial, Waterfront - This would cover all industrial activities requiring access to the harbor, such as port facilities, storage terminals for bulk products, ship building and repair. These activities would require the removal of dilapidated piers, piles of debris and any sunken vessels which could present a navigation hazard to approaching vessels.

Industrial, Non-Waterfront - This would include plants, depots and other industrial type activities which use land transportation exclusively without mobilization, of the harbor. A number of such facilities have been constructed adjacent to dilapidated piers. Shorefront debris does not significantly affect them , therefore, debris removal provides them no benefit.

28. In the many cases in which it is not possible to determine whether a given industrial use site will be redeveloped for a waterfront or non-waterfront use, half the clearance cost is assessed.

29. The expected future use for each given site was determined either from land use plans for the area or known redevelopment plans for the site. Where these are not available, it is assumed that redevelopment will be in conformance with local zoning ordinances. The volume of debris is obtained from the debris inventory, and the cost of removal and disposal is based on the unit cost of removal and disposal for each type of debris. The visual impact index is based on the judgment of inspectors who visited each debris source. It is for use as a reference only. The requirement for pier removal is determined from the above criteria. It takes into account both the visual aspect of the debris source and surrounding land use. It is on a scale of 0 to 3 where:

0 = No significant visual impact
1 = Slight negative visual impact
2 = Moderate negative visual impact
3 = Major negative visual impact

30. The benefit is calculated by first determining whether removal of the debris is necessary for redevelopment at each site. Where removal is necessary, the cost of removal and disposal of the debris at the site, and likely time of redevelopment were determined. The cost of removal and disposal were then discounted at the project interest rate of 7-1/8% for the period of development to determine the present worth. Annualized benefit was calculated by applying the project capital recovery factor of 0.07360 to the capitalized benefit.

Benefit

31. The total site enhancement value from debris removed and disposed of for each community is shown in Table B-4 (see Estimate of Property Value Enhancement, Appendix 4, Part B, 12 Tables).

32. The annualized benefit equals approximately $448,600.

TABLE B-4

BENEFIT FROM REDUCTION IN COST OF FUTURE DEVELOPMENT
(Present Worth Values)

	Residential	Recreational[2]	Industrial	Commercial	Total
Hull	53,924	163,820	-	-	217,744
Hingham	24,905	775	490,942	4,084	520,702
Weymouth	63,781	470	2,800	2,908	69,959
Braintree	-	-	265	-	265
Quincy	110,228	-	166,322	8,631	285,181
Boston	1,301,689	1,677,128	1,436,642	40,422	4,455,881
Cambridge	-	-	3,179	-	3,179
Somerville	-	-	9,755	-	9,755
Everett	-	-	165,403	-	165,403
Chelsea	3,468	-	290,095	-	293,563
Revere	-	-	13,373	-	13,373
Winthrop	41,572	583	-	17,727	59,882
Total	1,599,567	1,842,776	2,578,776	73,772	6,094,891

1. 7-1/8% discount rate.
2. Includes Public Open Space
3. Includes Industrial Waterfront Uses and Marinas

Increased Property Values In Areas Surrounding Debris Removal

33. The removal of debris sources, particularly dilapidated piers and loose piles of debris will remove a major eyesore from many residential areas. As previously described in Section B of Appendix 1, paragraph 42, an attractive outlook is given an appreciable value in Boston, as elsewhere. This value is estimated as a benefit of the project in terms of increased property prices.

Methodology

34. The methodology for calculating land enhancement benefits for the harbor debris cleanup is based on two studies:

a. A study published in December 1975 entitled Benefits From Water Pollution Abatement - Property Values prepared for the National Commission on Water Quality, which estimated the impact on property values that would be associated with the implementation of the Federal Water Pollution Act Amendments of 1972 P.L. 92-500 concerning point discharge of effluent into the nation's waters. (This study will be referred to as Study A throughout this section.)

b. A study entitled A Generic Methodology To Forecast Benefits From Urban Water Resource Improvement Projects prepared for the Office of Water Research and Technology, U.S. Department of the Interior, November 1974 which served as a base upon which Study A expanded. (This study will be referred to as Study B throughout this section.)

35. The rationale for examining property value changes as a means of analyzing benefits associated with water resource improvement had been established in Study B. "No one seriously doubts that water resource projects have value; the question is rather a quantitative one: how much value is there and in what units can this value be expressed? The difficulty in determining value basically stems from the fact that the output, the services of water resource projects, are not generally sold (either entirely or partially) in a market where their values can be established and determined. It has, however, been demonstrated that such projects can be evaluated by analyzing the implicit economic demand: that is, how people are indirectly spending their dollars to obtain the benefits generated by the new or improved resource. An obvious market to be analyzed then is the real estate market, for clearly, amenities which have locational relations to a piece of property are reflected in the market price for that property."

36. Both studies postulated a casual chain: that a change in the water quality of a given water resource is perceived to some degree by the residents of the area and it is their perception which then affects the value of nearby properties.

37. Three surveys were conducted to provide information for the regression analysis relating property value to residents' perceived water quality changes.

1. A general opinion survey (GOS) conducted in Study B, interviewed fifteen residents living near water resources, at each of nine sites different than the case study sites. These sites were chosen to be representative of different water bodies: rivers, lakes and bays, and different degrees of pollution that exist throughout the United States. Study A undertook refinements of various water quality descriptions developed in Study B and conducted a second GOS with an additional twenty-seven residents of one of the original nine sites to verify the validity of the alterations. Residents were asked to indicate for a given condition (these conditions are presented with Figure B-1) their feelings about the condition, if it were in all lakes, rivers, and bays, not just those that are nearby. To measure their feelings a line diagram was utilized with totally acceptable at one end of the scale and totally unacceptable at the other. By placing an X somewhere along this scale a measure of the residents feelings concerning a particular condition were obtained. On the basis of this analysis the curve shown in B-1 was established statistically using a standarized grid to evaluate survey responses. (Curves were derived for each of the aspects of water quality listed in the following table.)

In addition, these two surveys served as the basis for the development of an empirically constructed index to measure perceived water quality. They were used to determine the relative weightings of importance of water quality aspects utilized in the model. These values are as follows:

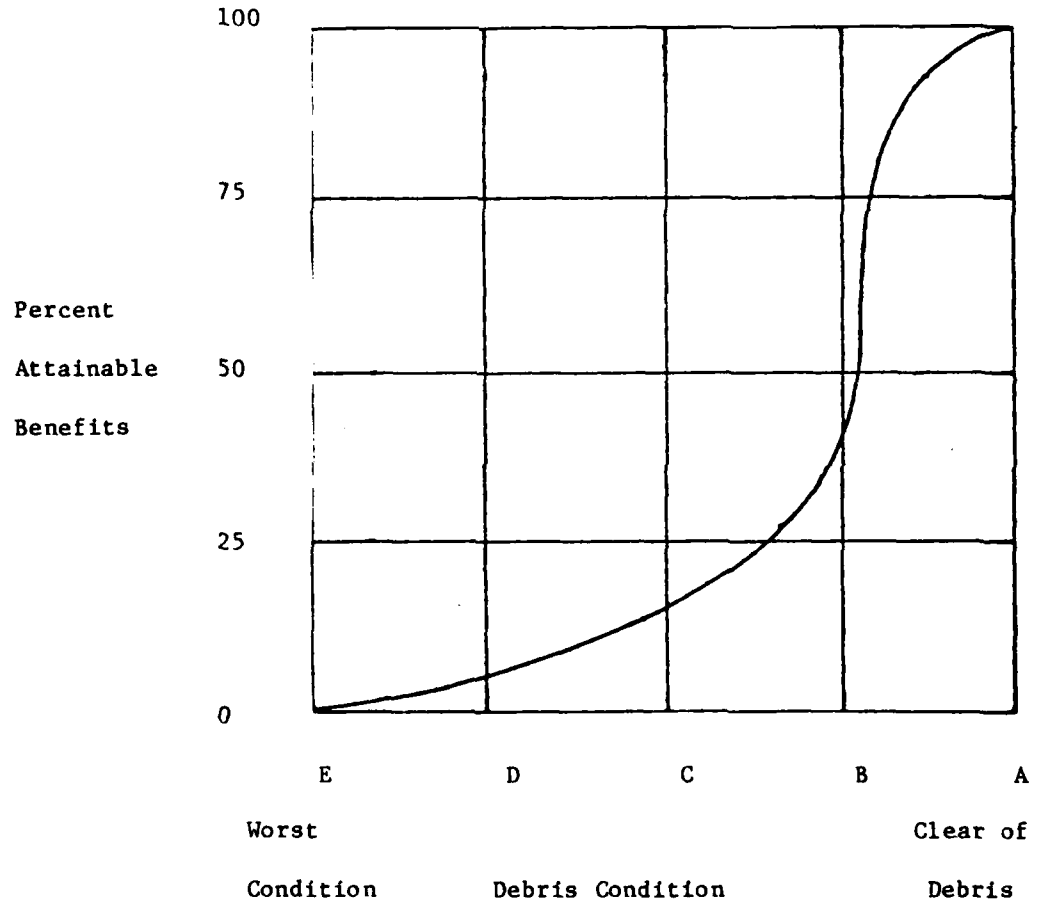
TABLE B-5

SURVEY WEIGHTINGS OF ASPECTS OF WATER QUALITY

		%
Wildlife Support Capacity		0.43
Aesthetics		
Absence of Industrial Wastes	0.10	
Clearness	0.07	
Absence of Odor	0.05	
Absence of Debris and Obstructions	0.05	
Absence of Algae	0.04	
All Aesthetics		0.31
Recreation Opportunity		0.26
		1.00

Figure B-1

Absence of Debris and Obstructions



Water Quality Condition	Description
A	There are a few natural objects (such as weeds, logs, or leaves) present in the water, but there are no man-made objects (such as tires, bottles or cans) in the water.
B	A moderate amount of natural objects (such as weeds, logs or leaves) as well as a few man-made objects (such as tires, bottles or cans) are present in the water.
C	A moderate amount of natural objects (such as weeds, logs or leaves) as well as a moderate amount of man-made objects (such as tires, bottles or cans) are present in the water.
D	A moderate amount of natural objects (such as weeds, logs or leaves) as well as a numerous man-made objects (such as tires, bottles or cans) are present in the water.
E	Numerous natural objects (such as weeds, logs or leaves) as well as numerous man-made objects (such as tires, bottles or cans) clutter the water.

2. A residential site survey (RSS) was conducted interviewing residents at each of the seventeen sites analyzed in Study A, utilizing the same water quality definitions that were developed and tested in the General Opinion Study. This was done to establish the residents' perceived water quality index ratings for the study sites. These sites formed the basis for the development of a relationship between property value changes and the perceived change in water quality.

3. An expert site survey (ESS) was conducted utilizing the same water quality definitions that were used in the General Opinion Survey and Residential Site Survey to determine if there was a systematic correlation between the perception of water quality changes as observed by the experts and those of area residents. The experts chosen were local water quality scientists and engineers possessing professional knowledge of the change in water quality at the case study sites.

38. Two factors emerged from the above surveys:

a. Residents perceived water quality ratings that were different from those of the experts, but consistent with the results of the regression analysis of perceived water quality change impacts on property values.

b. An informative publicity campaign regarding the improvement in water quality appeared to raise the level of the residents perceived water quality index.

39. These two studies also determined property value increases in relation to the distance of the property from the water. In order to determine the increase in property values, property values before and after the implementation of the improvements were investigated and adjusted to reflect general property price increases in the area so as to identify the increase attributable to water quality improvements. It was found that property value increases varied inversely with their distance to the waterfront.

40. On the basis of these studies, a mathematical relationship between price increases, water quality improvements as perceived by local residents,and distance from the waterfront was determined statistically as well as the limits of confidence. As a result, the following formulae were developed to calculate the increases in property values as a result of debris removal and other water quality improvements.

$$\Delta P\%_s = b_{0s} + b_{1s}(1/DW) \qquad -(1)$$

$$b_{0s} = -b_{1s}(1/DW_{max,s}) \qquad -(2)$$

$$b_{1s} = e^{6.398}(PWQl_{Res,s})^{0.492} e^{1.180(WBT\ Lake)} e^{0.991(WBT\ Bay)}$$

Where: $\Delta P\%$ is the percent increase in property values, DW is the distance from the improved water body.

Where: $DW_{max,s}$ is the maximum distance at which the influence of the improvement is felt.

Where: $PWQl_{Res,s}$ is the residents' "Perceived Water Quality Index" expressed as a percentage. This is based on the relative weighting given to different aspects of water quality, and the residents' perception of the improvement in that aspect.

41. It was found that residents perceived little improvement when an aspect of water quality went from very bad to bad or good to excellent. They perceived most improvement as conditions improved from bad to fair to good as measured by parameters established by experts.

42. The following matrix assists in determining the percent to which clean up would be affected.

TABLE B-6

PERCENT ATTAINABLE BENEFIT MATRIX
FOR DEBRIS AND OBSTRUCTIONS

Relative Weighting from Table 1 = 0.05

i \ TO / From \ j	E	D	C	B	A
E	0	5	15	41	100
D	-5	0	10	36	95
C	-15	-10	0	26	85
B	-41	-36	-26	0	59
A	-100	-95	-85	-59	0

43. The residents' "Perceived Water Quality Index" ($PWQI_{Res,s}$) is established by multiplying the residents' perception of the percent of attainable benefits by the survey weighting of the aspect of water quality under consideration. For example, if the debris condition improves D to B, the percent attainable benefit represents an improvement of 36%, and given a weighting for absence of debris and obstructions of 5% then $PWQI_{Res,s}$ of 36 x 0.05 = 1.80

Application

44. Department of the Army Engineering Regulation (ER) 1105-2-351 "Evaluation of Beneficial Contributions to National Economic Development for Flood Plain Management Plans" discusses the following benefit:

> "The location benefit is the value of making flood plain (land) available for new uses by reducing flood hazards to activities which would use the flood plain only with protection.... For consumers, the benefit standard is defined as the difference between the cost of obtaining a site of equivalent value in an alternative manner and the cost of locating on the protected flood plain.... Changes in market value of land can be used to measure location benefits. The value of land is established through market transactions and is influenced by buyers and sellers considering the estimated effects of risk, uncertainty, probability of higher use, and the time lapse before particular land parcels are expected to shift into a higher order of use. Consequently, market land value

represents the present capitalized value of the anticipated future income stream (rents) associated with the expected uses of the land. Changes in the market value of land can be used to measure the benefits to activities which would locate in the flood plain when there are important externalities associated with a plan."

The same external benefits can accrue from debris clean up. For flood control projects changes in the market value of property can be calculated based upon comparisons between flood prone land and flood free land. In the case of debris clean up a direct comparison is not possible.

The two studies, detailed above, were undertaken to formulate a methodology to determine property enhancement benefits from water pollution abatement. Given that these studies had been undertaken to answer questions similar to those raised in the Boston Harbor Debris Study, it was decided to utilize them as the basis for property enhancement benefit determination. Adaptation of the developed methodology was based upon a knowledge of the area and visual inspection with various adjustments being made in the model parameters so that they were more appropriate to the Boston Harbor site.

45. While the study was largely carried out in a suburban setting, it is nevertheless applicable to the urban setting in Boston inner harbor, so long as a relevant relationship can be established between the waterfront and surrounding areas. In the inner harbor such relationships occur in the North End and East Boston where residential areas abut closely to the waterfront and residents have access to it. The North End, however, has been excluded from the study area due to the existence of a buffer of industrial, commercial structures and a major roadway. The waterfronts of South Boston, Cambridge, Charlestown, Somerville, Everett, Chelsea and Revere which are within the study area and have significant debris sources, are cut off from their residential hinterland by industrial zones of sufficient depth. In this case, it would be hard to sustain any relationship between improved property values and debris removal. In most areas of the outer harbor, the debris sources are widely spread and unobtrusive, and it is felt that residents will be unable to perceive any significant benefit from their removal.

46. In East Boston, however, residential areas back closely onto the waterfront and, in most areas, reaching to the inland side of the waterfront service road. Areas of the waterfront consist of unused piers and are ripe for redevelopment. Some residential redevelopment has already occurred and more is planned. Houses with a view of the Boston skyline in the Jeffries Point area are being rehabilitated. The removal of dilapidated piers will be seen as a significant benefit by local residents. As previously explained, the

study was done in a suburban setting where it may be surmised that debris is not so obtrusive as in East Boston. Further, city dwellers cannot expect to create significant wildlife support capacity, clear water or recreational opportunities for water contact sports in a commercial port, but there is every indication that they perceive great value in a pleasant outlook. They are, therefore, likely to give additional weight to debris removal in East Boston and adjacent areas over which they have a view. In addition, the study revealed that while no regional variation in the attainable benefits could be detected, there were considerable variations between different types of communities dependent on their traditional relationships to water. Property values in an old maritime community were found to be more sensitive to changes in the water than those in small rural areas where water has not been viewed as an integral part of the community itself. East Boston is a traditionally maritime oriented community and, therefore, likely to be particularly sensitive to improvements to the harbor. Under these circumstances it appears reasonable to assume that debris removal should be more highly weighted for this area, therefore the weight accorded this type of water resource improvements was .10 for this study.

47. The cleanup will not result in perfect conditions or are conditions so bad at present as to be defined as "worst condition". It is reasonable to assume that existing conditions lie at the mid-point between E and D, and conditions with the debris removed will lie at the mid-point between B and A. Thus, it has been assumed that the implementation of the project could improve conditions by 68 percent of attainable benefits.

48. In Study B, discussed earlier, a public access variable was included multiplicatively in the determination of PWQI. The variable was defined as follows:

TABLE B-7

Degree of access	Coefficient c (access)
very limited less than 1 public access point per mile of shoreline	.74
limited 1-2 public access points per mile of shoreline	.85

Degree of access	Coefficient c (access)
good from 3 or more public access points per mile of shoreline to 2/3 of the shoreline	1.00
unlimited no private or other development restricting public access to the water body at the site	2.45

Study A did not use the variable based upon the following analysis:

> "Neither did the public access and use variable, PA, enter the key relation directly, although it is clearly correlated with the coefficient b_1 of the property price impact equation. This is due to the fact that PA is also strongly collinear with $PWQI_{Res}$. It must be concluded that the influence of public access and use on the impact of water quality impact is reflected via the perceived water quality change."

49. It was felt appropriate to reduce the level of possible attainable benefits at the East Boston site due to the limited access available. Therefore, the 68 percent of attainable benefits (paragraph 45) was multiplied by the very limited access figure of .74 (paragraph 46) to determine the realizable level.

A figure of 50 percent of attainable benefits was utilized as an input to the formula; i.e., 68% x .74 = 50%. (It should be noted that access should improve dramatically in this area in the future due to proposed and planned redevelopment).

50. On this basis:

$$PWQI_{Res,s} = \sum A_k B_{ijk}$$

A_k - relative valuation of water pollution abatement aspect k. In this case it is debris clean up and we have given it a valuation of .1 (see paragraph 44).

B_{ijk} - the percent attainable benefit for a change from condition i to condition j for aspect k. We have calculated this to be 50 (see paragraphs 46 and 47).

$$PWQI_{Res,s} = .1 \times 50 = 5.0$$

51. Continuing the calculation:

$$b_{1s} = e^{6.398}(5)^{0.492} e^{1.180(\text{WBT Lake})} e^{0.991(\text{WBT Bay})}$$

Since this is a harbor (similar to Bay)
WBT Lake = 0
WBT Bay = 1

Therefore

$$b_{1s} = e^{6.398}(5)^{0.492} e^{(1.180)(0)} e^{0.991(1)}$$
$$= (1618)(5)^{0.492}$$
$$= 3572$$

52. The second study indicated that the impact of water quality improvements generally vanish at about 4000 ft. from the water's edge. In the case of East Boston with its high housing densities, it is believed that the impact will not be discernible at over 2000 ft. and this is used as $DW_{max,s}$

53. The value of residential property by census tract in East Boston is given in a Boston Redevelopment Authority Memorandum.[1] The residential area of each tract within different distances from the bulkhead lines was determined, and $\Delta P\%$ calculated as presented in Table B-8.

TABLE B-8

Percent Increase in Property Values
as a Function of Distance

DW Mean	Distance Range	$\Delta P\% = b_{0s} + b_{1s}(1/DW)$
100 ft	0-200 ft	33.9
350 ft	200-500 ft	8.4
750 ft	500-1000 ft	3.0
1500 ft	1000-2000 ft	.6

$DW_{max,s}$ was assumed to be 2000 ft.

54. The percent increases in property values determined by the above methodology seem reasonable when compared to increases resulting from somewhat similar situations. When the Government Center Project was built in downtown Boston, a blighted area was cleaned up. The value of the property in the neighborhood of the project was significantly increased. At Boston's North End Waterfront area improvements have led to increased property values at Harbor Towers and Lewis Wharf. Condominiums at Lewis Wharf which first sold for $42,000 in 1973 are now sold for $60,000 and more.

55. Another point to be noted is that residential property values in East Boston have grown steadily during the past 25 years. The residential market value index has grown from 1.0 in 1955 to 4.237 in 1979. This shows that despite the debris problem the area has continued to hold potential. Since the area remains economically viable, a solution to the debris problem should encourage the reaching of full property value potential as the area becomes more aesthetically pleasing.

56. The values of properties within different distance ranges and the benefits which will accrue to these properties are presented in Table B-9. The annual benefit accruing to the project due to increased property values is $349,800 computed at an interest rate of 7-1/8%. It should be noted that if an increased property value benefit has been claimed for a site, no benefit for reduced development costs can be claimed for the same site.

1. Tables showing Boston's Housing Stock and Values by Census Tract, R. Goetze and E. Blaine, BRA, April 27, 1976.

TABLE B-9

PROPERTY VALUES

Census Tract No.	Total Value $ x 10^3	0-200	200-500	500-1000	1000-2000	Over 2000
501	19,787	228	1,716	12,124	5,719	
502	23,597			7,641	15,553	403
503	2,584	144	660	1,780		
504	8,250			5,555	2,695	
505	5,311				3,204	2,107
506	7,159			1,996	5,163	
507	7,084			1,705	5,379	
508	11,162				5,320	5,842
509	24,368	1,287	2,674	11,690	8,717	
510	28,182	2,461	3,243	4,697	17,781	
511	48,492	420	1,310	2,827	3,771	40,164
512	13,462		2,260	8,745	2,457	
Totals	199,438	4,540	11,863	58,760	75,759	48,516
P%		33.9	8.4	3.0	.6	0
Increase in Property Value		1,539	996	1,763	455	0

Total Increased Property Values = $4,753,000

Employment Benefits

57. In labor market areas which have been designated as redevelopment areas, the Water Resource Council's Principles and Standards directs that the project benefits shall be considered to be increased by the value of the local labor required for project construction. Otherwise, it is assumed, such labor would not be utilized or would be underutilized.

58. The Boston area qualifies as a Title IV redevelopment area under the substantial unemployment (category 3) criteria but does not meet the requirements for employment benefits under current regulations. (The area must also have persistent unemployment).

59. Employment benefits were calculated according to ER 1105-2-354 "Evaluation of NED Employment Benefits". Labor costs for each work element were broken down into various skill categories, i.e., skilled, semi-skilled, unskilled, etc. Then, applying percentages given in ER 1105-2-354, the local share of wages paid directly to previously unemployed and underemployed workers is measured.

60. Employment benefits, as concerns the selected plan, were calculated as detailed in Table B-10 amount to $1,898,545. On an annual basis this would be $139,700 at an interest rate of 7-1/8%.

DECREASED MAINTENANCE COST

61. Information from the State Environmental Quality Engineering Department shows that the Commonwealth spends approximately $50,000 annually to pick up drift from Boston Harbor. Implementation of the selected plan, by reducing debris by 90% would eliminate 90% of this cost. A benefit of .9($50,000)=$45,000 is taken for reduced maintenance cost to the Commonwealth of Massachusetts.

62. The benefits to the selected plan are summarized in Table B-11.

TABLE B-10

EMPLOYMENT BENEFITS

WORK ELEMENT	PROJECT WAGES	LOCAL FACTOR	LOCAL WAGES
Removal of Heavy Waterfront Structures			
Skilled Labor	$1,306,000	.30	$ 391,800
Semi-skilled Labor	627,400	.35	219,590
Unskilled Labor	990,175	.45	445,580
Driver	10,000	.30	3,000
Driver's Helper	7,245	.45	3,260
	SUBTOTAL:		$1,063,230
Removal of Light Waterfront Structures			
Skilled Labor	$ 43,630	.30	$ 13,090
Unskilled Labor	50,110	.45	22,550
	SUBTOTAL:		$ 35,640
Removal of Wrecked Vessels			
Skilled Labor	$ 202,260	.30	$ 60,790
Semi-skilled Labor	88,790	.35	31,080
Unskilled Labor	171,840	.45	77,330
	SUBTOTAL:		$ 169,200
Removal of Loose Onshore Debris			
Skilled	$ 95,735	.30	$ 28,720
Unskilled	105,095	.45	47,290
	SUBTOTAL:		$ 76,010

TABLE B-10

EMPLOYMENT BENEFITS (continued)

WORK ELEMENT	PROJECT WAGES	LOCAL FACTOR	LOCAL WAGES
Collection of Drift Material			
Skilled	$239,250	.30	$ 71,780
Unskilled	261,000	.45	117,450
	SUBTOTAL:		$189,230
Unloading of Drift Material			
Skilled	$259,580	.30	$ 77,870
Processing --- Burying			
Skilled	$160,220	.30	$ 48,065
Repair to Structures			
Skilled	$319,059	.30	$ 95,720
Unskilled	319,059	.45	143,580
	SUBTOTAL:		$239,300
TOTAL LOCAL WAGES ELIGIBLE FOR BENEFIT:			$1,898,545

TABLE B-11

Benefit Summary

	Present Value	Average Annual Benefit 7-1/8 %
Navigation Benefit	$9,578,300	$ 705,000
Reduction in Cost of Future Development	6,094,891	448,600
Property Enhancement	4,753,000	349,800
Reduction in Maintenance Costs to Massachusetts		45,000
TOTAL BENEFITS		$1,548,400

*Employment Benefits Excluded

BOSTON HARBOR, MASSACHUSETTS

FEASIBILITY REPORT

FOR DEBRIS REMOVAL

Display of Alternative Plan Effects

APPENDIX 3

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

DECEMBER 1979
(REVISED MAY 1980)

TABLE OF CONTENTS

TABLES

Display of Alternative Plan Effects

1. The U.S. Water Resources Council's Principles and Standards procedures require that all alternative plans carried through the final planning stage be evaluated against both planning objectives and their contributions to four accounts: National Economic Development, Environmental Quality, Social Well-Being, and Regional Development. The significant beneficial and adverse impacts of each alternative are displayed in the System of Accounts. In addition, the System of Accounts describes each alternative carried through the final planning stage, displays the planning objectives, presents each plan's performance against the specified evaluation criteria, and indicates the timing, geographical incidence, uncertainty, exclusivity and actuality associated with the evaluation of significant impacts. The selection of a plan of improvement for the study area involved the comparison of the various alternatives that satisfy the formulation and evaluation criteria. The screening process revealed that four (i.e., numbers 3,4,6 and 7) of the seven action alternatives are merely higher cost variations of debris transfer operations presented in the remaining three. Therefore, they have been eliminated as competing laternatives. Those remaining, alternatives 2,5 and 8, are shown in Table 1, System of Accounts.

Alternatives Displayed

2. The following cleanup alternatives are displayed in the System of Accounts:

a. Debris collection and removal and disposal by burning on vessels at sea (Plan 2).

b. Debris collection and removal and disposal by burning in an incinerator (Plan 5).

c. Debris collection and removal and disposal in an existing sanitary landfill (Plan 8).

Planning Objectives

3. The primary planning objectives are to determine the extent and seriousness of the problems caused by these debris sources,develop a plan

to correct these problems, estimate the cost of corrective work, determine the extent of federal participation and to satisfy environmental considerations.

National Objectives

4. Principles and Standards require that alternative plans carried through the final planning stage must be evaluated against the four national accounts. There are National Economic Development, Environmental Quality, Social Well-Being and Regional Development. Section 122 of the River and Harbor and Flood Control Act of 1970 further requires that, at a minimum, the following effects must be identified and assessed:

SOCIAL EFFECTS	ECONOMIC EFFECTS
Noise	Tax Revenues
Displacement of People	Property Values
Esthetic Values	Public Facilities
Community Cohesion	Public Services
Community Growth	Regional Growth
	Employment/Labor Force
	Business and Industrial Activity
	Displacement of Farms

ENVIRONMENTAL EFFECTS

Man-Made Resources
Natural Resources
Air
Water

Regions Displayed

5. Principles and Standards require that all regions in which a significant impact occurs be displayed. Of the regions suggested for inclusion, only the planning area and the remainder of the nation are shown since no significant impacts occur in other areas. The following paragraphs define the areas included:

a. The planning or study area is Boston Harbor. The area served by the harbor and directly affected by the considered cleanup alternatives include the towns of Hull, Hingham, Weymouth,

Braintree; the cities of Quincy, Boston, Cambridge, Somerville, Everett, Chelsea, and Revere; and the town of Winthrop which border the harbor.

b. Remainder of the Nation. In the study, the "Remainder of the Nation" refers to the area outside the study area. Display of this region is a requirement of Principles and Standards.

Evaluation Criteria

6. Principles and Standards require that specified evaluation criteria be applied to alternative plans and their impacts to test their responsiveness. These criteria and the coding used in the System of Accounts displays are listed below:

a. Timing

Code

1 Impact is expected to occur prior to or during plan implementation.

2 Impact is expected to Occur within 15 years following plan implementation.

3 Impact is expected to occur later than 15 years following plan implementation.

4 Impact occurs at indicated period and continues for an indefinite future period.

b. Uncertainty

Code

4 Level of uncertainty associated with the impact is greater than 50 percent.

5 Level of un ertainty is between 10 and 50 percent.

6 Level of uncertainty is between 0 and 10 percent.

c. Exclusivity

Code

7 Overlapping entry; fully monetized in NED account.

8 Overlapping entry; not full monetized in NED account.

d. Actuality

Code

9 Impact will occur with implementation.

10 Impact will occur only when specific additional actions are carried out during implementation.

11 Impact will not occur because necessary additional actions are lacking.

The following System of Accounts, Table 1, displays three alternatives for cleaning Boston Harbor of its sources of drift and debris considered hazardous to navigation and a suppressant to land values and a blight on affected communities. Alternative eight was selected based on its capability to maximize project benefits. As a result, it was chosen to be the National Economic Development (NED) Plan. It also provides the greatest positive input to the Environmental Quality (EQ) account. Therefore, the collection, removal and disposal in a sanitary landfill of drift and debris sources was selected as the NED oriented EQ Plan.

TABLE 1 - SYSTEM OF ACCOUNTS
ACTION CLEANUP PLANS
BOSTON HARBOR, MASSACHUSETTS

ALTERNATIVE 2

	CODE	Debris Collection and Removal and Disposal by Burning on Vessels at Sea		Debri Dispo
		Planning Area Boston Harbor	Remainder of the Nation	Plann Bosto
1. NATIONAL ECONOMIC DEVELOPMENT IMPLEMENTATION				
a. Plan Operation Costs				
. Collection		1,398,000		1,3
. Removal		12,926,000		12,9
. Disposal		3,271,000		4,1
. Repair		2,887,000		2,8
b. Implementation Costs				
. Federal		2,623,000	U.S. share	2,6
. Non-Federal		17,859,000	of cost is	18,7
. Total	1	20,482,000	2.63 mil.	21,3
c. Average Annual Benefits				
. Reduction in the Number of Boat-Drift Collisions		705,000		7
. Increase Property Value of Debris Site		448,600		4
. Increased Property Values of Adjacent Sites		379,800		3
. Reduction in Maintenance Costs to MA		45,000		
. Total		1,548,400		1,5
d. Average Annual Charges				
. Total Plan	1,7	1,517,000		1,5
e. Benefit Cost Ratio		1.02		

/

SYSTEM OF ACCOUNTS
LEANUP PLANS
MASSACHUSETTS

2

ALTERNATIVE 5			ALTERNATIVE 8	
oval and essels at Sea	Debris Collection and Removal and Disposal by Burning in an Incinerator		Debris Collection and Removal and Disposal in an Existing Sanitary Landfill	
Remainder of the Nation	Planning Area Boston Harbor	Remainder of the Nation	Planning Area Boston Harbor	Remainder of the Nation
	1,398,000		1,398,000	
	12,926,000		12,926,000	
	4,157,000		2,253,000	
	2,887,000		2,887,000	
U.S. share of cost is 2.63 mil.	2,663,000	U.S. share of cost is 2.66 mil.	2,583,000	U.S. share of cost is 2.58
	18,705,000		16,881,000	
	21,368,000		19,464,000	
	705,000		705,000	
	448,600		448,000	
	379,800		379,800	
	45,000		45,000	
	1,548,400		1,548,400	
	1,581,400		1,447,700	
	0.98		1.07	

(Revised June 1980)

APPENDIX 3
Sheet 1 of 8
Rev. May 1980

TABLE 1 SYSTEM OF ACCOUNTS
BOSTON HARBOR, MA

		ALTERNATIVE 2		
		Debris Collection and Removal and Disposal by Burning on Vessels at Sea		Debris Co Disposal
		Planning Area Boston Harbor	Remainder of the Nation	Planning Boston Ha
2. ENVIRONMENTAL QUALITY (EQ)				
a. Beneficial Impacts				
(1) Man-made Resources- conserve man-made resources by reducing the number of boat-drift collisions and by repairing rather than replacing certain damaged waterfront structures		(1) Yes		(1) Yes
(2) Improve Water Cleaniness	4,6,8,9	(2) Yes		(2) Yes
b. Adverse Impacts				
(1) Archaeological/Historical Resources may disturb A/H Resources	4,5,8,9	(1) Impact Unknown pending further study		(1) Imp pen stu
(2) Air Quality Reduces air quality during plan implement-ation	1,6,8,9	(2) Significant in burn areas only		(2) Min
(3) Water Quality				
(a) Increases in turbidity and release of heavy metals during collection and removal	1,6,8,9	(a) Minor		(a) Min
(b) Pollutants (ash, etc.) will fall into the ocean during the burn	1,6,8,9	(b) Minor		(b) N/A

TEM OF ACCOUNTS
TON HARBOR, MA

	ALTERNATIVE 5		ALTERNATIVE 8	
and at Sea	Debris Collection and Removal and Disposal by Burning in an Incinerator		Debris Collection and Removal and Disposal in an xisting anitary andfill	
ainder the Nation	Planning Area Boston Harbor	Remainder of the Nation	Planning Area Boston Harbor	Remainder of the Nation
	(1) Yes		(1) Yes	
	(2) Yes		(2) Yes	
	(1) Impact unknown pending further study (2) Minor		(1) Impact unknown pending further study (2) None	
	(a) Minor		(a) Minor	
	(b) N/A		(b) N/A	

APPENDIX 3
Sheet 2 of 8

TABLE 1 SYSTEM OF ACCOUNTS
BOSTON HARBOR, MA

ALTERNATIVE 2

	CODE	Debris Collection and Removal and Disposal by Burning on Vessels at Sea		Debris C Disposal
		Planning Area Boston Harbor	Remainder of the Nation	Planning Boston H
(4) Natural Resources causes displacement or destruction of organisms living on or around the wreckage or piers to be removed	1,6,8,9	(4) No effect on the ecological integrity of the area		(4) No eco rit
(5) Habitats Destruction of habitats of organisms living on the wreckage of piers to be removed	4,6,8,9			
(a) Common Tern-with piers used as nesting sites allowed to remain		(a) No effect		(a) No
(b) Common Tern-with nesting piers removed		(b) Potentially significant negative effect on regional common tern population		(b) Po ni ef co ti
(c) All other organisms		(c) No effect on the ecological integrity of the area		(c) No ec of

OF ACCOUNTS
HARBOR, MA

2	ALTERNATIVE 5		ALTERNATIVE 8	
oval and ssels at Sea	Debris Collection and Removal and Disposal by Burning in an Incinerator		Debris Collection and Removal and Disposal in an Existing Sanitary Landfill	
Remainder of the Nation	Planning Area Boston Harbor	Remainder of the Nation	Planning Area Boston Harbor	Remainder of the Nation
	(4) No effect on the ecological integrity of the area		(4) No effect on the ecological integrity of the area	
	(a) No effect		(a) No effect	
	(b) Potentially significant negative effect on regional common tern population		(b) Potentially significant negative effect on regional common tern population	
ty	(c) No effect on the ecological integrity of the area		(c) No effect on the ecological integrity of the area	

2

TABLE 1 SYSTEM OF ACCOUNTS
BOSTON HARBOR, MA

ALTERNATIVE 2

	CODE	Debris Collection and Removal and Disposal by Burning on Vessels at Sea: Planning Area Boston Harbor	Remainder of the Nation	Debri Dispo: Planni Bosto
3. SOCIAL WELL BEING (SWB)				
a. Beneficial Impacts				
(1) Aesthetic Values *				
(a) Increases Open Space	1,6,9	(a) Yes, slight impact at sites	(a) None	(a)
(b) Improves visual impact of shoreline areas	1,6,8,9	(b) Yes, impact significant in areas of debris concentration	(b) None	(b)
(2) Displacement of People *		(2) None	(2) None	(2)
(3) Community Cohesion *				
(a) Strengthens existing community patterns	2,6,9	(a) Yes, impact could be significant in areas of debris concentration	(a) None	(a)
(4) Life, Health, and Safety				
(a) Decreases threat to life and safety of recreational boaters	1,6,9	(a) Yes, significant impact	(a) None	(a)
(b) Decreases threat to health and safety of neighborhood children in debris located areas	1,6,9	(b) Yes, significant impact	(b) None	(b)
(5) Local Desires				
(a) Is consistent with local desires	2,6,9	(a) No, burning at sea is not desired by locals	(a) None	(a)

TEM OF ACCOUNTS
TON HARBOR, MA

2	ALTERNATIVE 5		ALTERNATIVE 8	
oval and ssels at Sea	Debris Collection and Removal and Disposal by Burning in an Incinerator		Debris Collection and Removal and Disposal in an Existing Sanitary Landfill	
Remainder of the Nation	Planning Area Boston Harbor	Remainder of the Nation	Planning Area Boston Harbor	Remainder of the Nation
(a) None	(a) Yes, same as Alternative 2	(a) None	(a) Yes, same as Alternative 2	(a) None
(b) None	(b) Yes, same as Alternative 2	(b) None	(b) Yes, same as Alternative 2	(b) None
(2) None	(2) None	(2) None	(2) None	(2) None
(a) None	(a) Yes, same as Alternative 2	(a) None	(a) Yes, same as Alternative 2	(a) None
(a) None	(a) Yes, same as Alternative 2	(a) None	(a) Yes, same as Alternative 2	(a) None
(b) None	(b) Yes, same as Alternative 2	(b) None	(b) Yes, same as Alternative 2	(b) None
(a) None	(a) Yes	(a) None	(a) Yes	(a) None

2

TABLE 1 SYSTEM OF ACCOUNTS
BOSTON HARBOR, MA

ALTERNATIVE 2

	CODE	Debris Collection and Removal and Disposal by Burning on Vessels at Sea		Debris C Disposal
		Planning Area Boston Harbor	Remainder of the Nation	Planning Boston
(6) Desireable Community Growth*				
(a) Agrees with long range land use plans	2,6,9	(a) Yes	(a) None	(a) Ye
(7) Transportation reduces threat to commercial marine transportation due to debris	1,6,9	(7) Yes, slight impact	(7) None	(7) Ye Al
(8) Leisure opportunities (increase recreational boating opportunities)	2,6,9	(8) Yes, slight impact	(8) None	(8) Ye Al
b. Adverse Impacts				
(1) Noise *				
(a) Creates temporary increase in noise levels during plan implementation	1,6,9	(a) Yes, slight increase in noise due to debris collection	(a) None	(a) Ye cr co po
(2) Aesthetic Values *				
(a) Creates temporary disruption of aesthetic values during plan implementation	1,6,9	(a) Yes, minor disruption due to collection and burning of debris	(a) None	(a) Ye ti ha of
(3) Transportation disrupts traffic between transfer and disposal sites during plan implementation	1,6,9	(3) No	(3) None	(3) Mi

STEM OF ACCOUNTS
STON HARBOR, MA

	ALTERNATIVE 5		ALTERNATIVE 8	
val and els at Sea	Debris Collection and Removal and Disposal by Burning in an Incinerator		Debris Collection and Removal and Disposal in an Existing Sanitary Landfill	
Remainder of the Nation	Planning Area Boston Harbor	Remainder of the Nation	Planning Area Boston Harbor	Remainder of the Nation
(a) None	(a) Yes	(a) None	(a) Yes	(a) None
(7) None	(7) Yes, same as Alternative 2	(7) None	(7) Yes, same as Alternative 2	(7) None
(8) None	(8) Yes, same as Alternative 2	(8) None	(8) Yes, same as Alternative 2	(8) None
(a) None	(a) Yes, slight increase due to debris collection and transportation	(a) None	(a) Yes, same as Alternative 5	(a) None
(a) None	(a) Yes, minor disruption due to collection, hauling and burning of debris	(a) None	(a) Yes, limited to minor disruption due to collection and hauling of debris	(a) None
(3) None	(3) Minor	(3) None	(3) Minor	(3) None

TABLE 1 SYSTEM OF ACCOUNTS
BOSTON HARBOR, MA

ALTERNATIVE 2

	CODE	Debris Collection and Removal and Disposal by Burning on Vessels at Sea		Debris C Disposal
		Planning Area Boston Harbor	Remainder of the Nation	Planning Boston H
4. REGIONAL DEVELOPMENT				
a. Beneficial Impacts*				
(1) Taxes and local government expenditure* (increased property values and tax revenue)	2,6,8,9	(1) Yes, significant impact at sites near residential areas where debris is obstructive	(1) None	(1) Yes Alt
(2) Desireable Community Growth*				
(a) Encourages redevelopment of previously developed land	1,6,9	(a) Yes, significant impact at sites	(a) None	(a) Yes Alt
(b) Encourage port development	2,6,9	(b) Yes, slight impact	(b) None	(b) Yes Alt
(3) Stabilizes neighborhoods along waterfront	2,6,9	(3) Yes, slight impact	(3) None	(3) Yes Alt
(4) Employment*				
(a) Increases employment during implementation	1,6,8,9	(a) Yes, temporary increase associated with project	(a) None	(a) Yes Alt
(b) Encourages increases in employment due to stimulation of port redevelopment	2,6,9	(b) Yes, slight impact	(b) None	(b) Yes Alt
(5) Displacement of Farms*		(5) None	(5) None	(5) No

M OF ACCOUNTS
N HARBOR, MA

2	ALTERNATIVE 5		ALTERNATIVE 8	
oval and ssels at Sea	Debris Collection and Removal and Disposal by Burning in an Incinerator		Debris Collection and Removal and Disposal in an Existing Sanitary Landfill	
Remainder of the Nation	Planning Area Boston Harbor	Remainder of the Nation	Planning Area Boston Harbor	Remainder of the Nation
(1) None	(1) Yes, same as Alternative 2	(1) None	(1) Yes, same as Alternative 2	(1) None
(a) None	(a) Yes, same as Alternative 2	(a) None	(a) Yes, same as Alternative 2	(a) None
(b) None	(b) Yes, same as Alternative 2	(b) None	(b) Yes, same as Alternative 2	(b) None
(3) None	(3) Yes, same as Alternative 2	(3) None	(3) Yes, same as Alternative 2	(3) None
(a) None	(a) Yes, same as Alternative 2	(a) None	(a) Yes, same as Alternative 2	(a) None
ith (b) None	(b) Yes, same as Alternative 2	(b) None	(b) Yes, same as Alternative 2	(b) None
(5) None	(5) None	(5) None	(5) None	(5) None

TABLE 1 SYSTEM OF ACCOUNTS
BOSTON HARBOR, MA

ALTERNATIVE 2

	CODE	Debris Collection and Removal and Disposal by Burning on Vessels at Sea		Debris C Disposal
		Planning Area Boston Harbor	Remainder of the Nation	Planning Boston H
(6) Income				
(a) Increases the real income of the area due to construction, employment and related expenditures	1,6,8,9	(a) Yes, slight impact	(a) None	(a) Yes Alt
(b) Increases real wealth via increases in property values	1,6,8,9	(b) Yes, significant impact in areas bordering on obtrusive debris sites	(b) None	(b) Yes Alt
(c) Increases real income to the extent that the project stimulates port redevelopment	2,6,9	(c) Yes, slight impact	(c) None	(c) Yes Alt
(7) Business and Industrial Activity*				
(a) Increases business and industrial activity to the extent that the project stimulates port redevelopment	2,6,9	(a) Yes, slight impact	(a) None	(a) Yes Alt
(8) Land Use		(8) Temporary-10 acres at Boston transfer sites	(8) None	(8) Tem at and fer

TEM OF ACCOUNTS
TON HARBOR, MA

2	ALTERNATIVE 5		ALTERNATIVE 8	
oval and ssels at Sea	Debris Collection and Removal and Disposal by Burning in an Incinerator		Debris Collection and Removal and Disposal in an Existing Sanitary Landfill	
Remainder of the Nation	Planning Area Boston Harbor	Remainder of the Nation	Planning Area Boston Harbor	Remainder of the Nation
(a) None	(a) Yes, same as Alternative 2	(a) None	(a) Yes, same as Alternative 2	(a) None
(b) None	(b) Yes, same as Alternative 2	(b) None	(b) Yes, same as Alternative 2	(b) None
(c) None	(c) Yes, same as Alternative 2	(c) None	(c) Yes, same as Alternative 2	(c) None
(a) None	(a) Yes, same as Alternative 2	(a) None	(a) Yes, same as Alternative 2	(a) None
(8) None	(8) Temporary 10 acres at both the Boston and Hingham transfer sites	(8) None	(8) Temporary 10 acres in both the Boston and transfer sites. Permanent-3 acres.	(8) None

TABLE 1 SYSTEM OF ACCOUNTS
BOSTON HARBOR, MA

ALTERNATIVE 2

	CODE	Debris Collection and Removal and Disposal by Burning on Vessels at Sea		Debris C Disposal
		Planning Area Boston Harbor	Remainder of the Nation	Planning Boston H
(9) Public Facilities and Services*				
(a) Decreases potential demand for rescue services for damaged recreational boats	1,6,9	(a) Yes, slight impact	(a) None	(a) Yes Alt
(b) Enhancement of existing parks and public lands	1,6,9	(b) Yes, slight impact at sites of debris	(b) None	(b) Yes Alt
(c) Enhancement of planned public redevelopment plans	1,6,9	(c) Yes, slight impact at sites	(c) None	(c) Yes Alt
b. Adverse Impacts				
(1) Relocations Required Requires relocation of miscellaneous marine equipment and mooring of some small boats	1,6,9	(1) Yes, at structures found dilapidated in use	(1) None	(1) Yes Alt

M OF ACCOUNTS
N HARBOR, MA

2	ALTERNATIVE 5		ALTERNATIVE 8	
oval and ssels at Sea	Debris Collection and Removal and Disposal by Burning in an Incinerator		Debris Collection and Removal and Disposal in an Existing Sanitary Landfill	
Remainder of the Nation	Planning Area Boston Harbor	Remainder of the Nation	Planning Area Boston Harbor	Remainder of the Nation
(a) None	(a) Yes, same as Alternative 2	(a) None	(a) Yes, same as Alternative 2	(a) None
(b) None	(b) Yes, same as Alternative 2	(b) None	(b) Yes, same as Alternative 2	(b) None
(c) None	(c) Yes, same as Alternative 2	(c) None	(c) Yes, same as Alternative 2	(c) None
(l) None	(l) Yes, same as Alternative 2	(l) None	(l) Yes, same as Alternative 2	(l) None